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Hemlo Area

District of Thunder Bay

by T.L. Muir

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FOREWORD

HEMLO AREA

Two detailed mapping projects were initiated in the Heron Bay Area in 1977 and in the Hemlo Area in 1978 by the Ontario Geological Survey, Ministry of Natural Resources.

These projects were part of a long-range program to provide up-to-date mapping of the Wawa part of the Abitibi Subprovince and information on known gold occurrences.

These two projects have served to provide a more effective data base for determining the mineral potential of this region with specific emphasis on guides to exploration of the known gold occurrences of the Hemlo Area.

It should be noted that, at present (March 1982), Teck Corporation is planning feasibility studies for production of the recently developed gold deposit of Corona Resources Limited.

E.G. Pye
Director
Ontario Geological Survey

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GEOLOGICAL MAP

(back pocket)

Map 2452 (coloured)–Hemlo Area, District of Thunder Bay.
Scale 1:31 680 (1 inch to ½ mile).

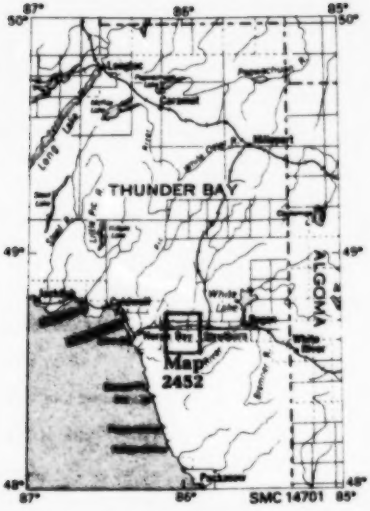

Figure 1–Key map showing location of Hemlo Area, scale 1 inch to 50 miles.

ABSTRACT

The Hemlo area is located in the District of Thunder Bay, about 350 km east of Thunder Bay by road. The 415 km^2 area lies in the Superior Province of the Canadian Shield. The area is part of a small greenstone belt, an eastern extension of the Schreiber-Marathon Belt, that is terminated in the west by Lake Superior and in the east by granitic terrain. The Abitibi Belt lies further to the east.

Two easterly-trending sequences of Early Precambrian (Archean) supracrustal rocks are present. The Heron Bay Sequence consists of the following: mafic flows, that are tholeiitic basalts, mixed with calc-alkalic volcanic rocks that are mostly dacitic, but range from basalt to rhyolite; and closely related metasediments. The Playter Harbour Sequence consists almost entirely of mafic flows of tholeiitic basalt composition. The two sequences may be directly related to each other, and at one time, may have been joined in the area of Mussy and Cache Lakes. In the Heron Bay Sequence, there is a crude, lateral facies change west to east as follows: intermediate to felsic pyroclastic rocks; metasediments derived from unlithified volcanic material of intermediate to felsic composition; and mudstones and wackes largely derived from epiclastic volcanic detritus. The supracrustal rocks have been metamorphosed under low-grade, and locally, medium-grade conditions.

Early Precambrian ultramafic and mafic intrusive rocks consist of lherzolite, pyroxenite, and related gabbro that have intruded the mafic volcanic rocks of the Playter Harbour Sequence.

Four, large, Early Precambrian (Archean) granitic bodies separate the supracrustal sequences. The Pukaskwa Gneissic Complex consists mainly of variable, foliated, lineated, and gneissic biotite-hornblende trondhjemite and granodiorite that contains phenocrysts of plagioclase and is protomylonitic along its margins. The Gowan Lake Pluton consists mainly of lineated to massive biotite-hornblende quartz monzonite with microcline phenocrysts, and finer grained, massive, biotite-hornblende quartz monzonite. The Heron Bay Pluton consists mainly of massive, hornblende-biotite granodiorite which locally contains microcline or plagioclase phenocrysts. The Cedar Lake Pluton is similar to the Heron Bay Pluton and consists of hornblende-biotite granodiorite. Late dikes of feldspar porphyry, aplite, and pegmatite have intruded the supracrustal and granitic rocks.

Middle to Late Precambrian, northerly-trending, subalkalic diabase dikes have a tholeiitic basalt composition and intruded all of the Early Precambrian rocks. Late Precambrian (Proterozoic) alkalic lamprophyre and other alkalic dikes also cut the Early Precambrian rocks.

Thick deposits of fine sand, silt, and clay are present in parts of the Hemlo area, and are particularly thick in the Black River valley.

Numerous lineaments are present in the Pukaskwa Gneissic Complex. Strike slip(?) faults are suspected in parts of the Heron Bay Sequence that parallels the contacts of the Pukaskwa Gneissic Complex in the east. Major folding may be present west of Mussy Lake.

Mineral exploration activity has concentrated on the search for gold, and to a lesser degree, silver. The gold is generally found associated with pyritiferous, feldspar and quartz-feldspar porphyry dikes. Although the mineral deposits are small, they may have future potential.

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CONVERSION FACTORS FOR MEASUREMENTS IN ONTARIO GEOLOGICAL SURVEY PUBLICATIONS

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE–Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

Geology of the Hemlo Area Thunder Bay District

by

T.L. Muir[1]

INTRODUCTION

Location

The Hemlo area covers an area of 415 km^2 within the District of Thunder Bay and is located 350 km from Thunder Bay and 430 km from Sault Ste. Marie by road. The area is bounded by Latitudes 48°33′N and 48°45′N and Longitudes 85°52′30″W and 86°07′30″W. Part of the area contains much of Lecours and Bomby Townships (formerly Townships 74 and 73 respectively) and a small part of Cotte Township (formerly Township 75); the remainder is unsurveyed territory. Hemlo presently consists of several cottages located at the north end of Cache Lake, and is accessible by road from Highway 17. Hemlo formerly was a small pulp and paper, railroad, and Ministry of Natural Resources settlement.

Means of Access

The best access is provided by Highway 17 (Trans-Canada Highway) and the Canadian Pacific Railway which cut across the northern third of the area in an east-west direction. Canoe access to the northern part of the area is provided by the meandering Black River and limited access to the southwestern part is provided by the White River. A poorly-maintained hydro access road gives accessibility by four-wheel-drive vehicle to the western part of the area south of Highway 17; an unmaintained old logging road gives limited access from High-

[1]Geologist, Precambrian Section, Ontario Geological Survey, Toronto.
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way 614 to the northeastern part of the area. Six lakes can be used by float-equipped aircraft; these are Gowan, Cache, Mussy[1], Hayward, Herrick, and Ell Lakes. A helicopter would be necessary to gain access into the most remote parts of the area, such as that in the northwest corner of the area.

Physiography

The area is characterised by moderate relief, but relief locally ranges from as much as 230 m on steep-sided hills to very little where terrain comprises large, flat-lying swampy, or sandy areas. Some sandy areas such as those west of Mussy Lake, the northeast corner of the map-area, and the Black River valley have been incised up to as much as 30 m by streams and their tributaries. The Black River valley deposits consist of glaciolacustrine sand, silt, and varved clay. The drainage system is disorganized, and all water eventually flows into Lake Superior.

Bedrock is usually not exposed in extensive, flat-lying areas, but is well exposed in areas of much greater relief; a lichen and moss cover is common on rock surfaces. Lineaments are common in the Pukaskwa Gneissic Complex in a zone 5 km wide from the contact with the volcanic rocks. Erosion along these features has created a large scale, blocky topography in this section of the area.

Previous Geological Work

The first geological mapping in part of the Hemlo area was done in 1930 by J.E. Thompson (1931) as part of a much larger area which was mapped to the west. M.W. Bartley and T.W. Page (1957) assembled a geological report for the Department of Industrial Development of the Canadian Pacific Railway on the "Hemlo Area" which also included a large area to the north and east of this report area. Ontario Government compilation maps that include the Hemlo area have since been issued; these are V.G. Milne (1968), Gerald Bennett *et al.* (1969), and Ontario Department of Mines Map 2220 (1972). The Heron Bay area, which adjoins the Hemlo area on the west, was mapped in 1977 by T.L. Muir and E.S. Barnett (1981); also *see* T.L. Muir (1979).

Present Field Work

The field work for this geological survey was carried out during the summer of 1978, as reported in the Summary of Field Work (Muir 1978). Vertical air photographs at a scale of 1:15 840 (1 inch to ½ mile) which were supplied by the Timber Branch, Ontario Ministry of Natural Resources, were used for mapping and planning on traverses. Traverses were made by the pace and compass

[1]Mussy Lake and Mussy Creek have been incorrectly spelled on Map 2452, back pocket.

method, and were spaced at intervals selected to provide sufficient coverage for most of the area. Geology is not tied to surveyed lines. Much bad weather during the field season impeded field work to such an extent that the southeast part of the area was not fully covered. Information obtained from traversing was plotted on Forest Resource Inventory basemaps numbered 485854, 486854, 485861, and 486861. Recent information with respect to roads, powerlines, buildings, and earth surface features was added to the basemaps.

Acknowledgments

The author was assisted in the field by Jean Lafleur who was the senior assistant and by Stanley Kolenko, Elizabeth Parry, and Daniel Wright who were junior assistants. Their help is greatly appreciated by the author. Thanks are also given to the Liebens of Terrace Bay.

GENERAL GEOLOGY

The Hemlo Area is largely underlain by granitic rocks which separate two sequences of metavolcanic and metasedimentary rocks. These sequences are:

1) The Playter Harbour Sequence which extends from Lake Superior eastward to Mussy Lake and consists mainly of metamorphosed high-iron tholeiitic basalt flows;

2) The Heron Bay Sequence to the north which extends from Lake Superior, near Heron Bay, east-northeast across the Hemlo Area and consists mainly of metamorphosed, intermediate to felsic calc-alkalic pyroclastic rocks, related sedimentary rocks, and high-iron tholeiitic basalt flows.

The latter sequence bifurcates around the Cedar Lake Pluton to the east-southeast and northeast. A narrow, disrupted segment of mafic metavolcanics almost joins the Playter Harbour Sequence with the Heron Bay Sequence between Mussy and Cache Lakes. It is suspected that the join was once complete.

In part of the Heron Bay Sequence, a poorly-defined lateral facies change occurs from west to east from predominantly pyroclastic rocks to mainly well-bedded and poorly-bedded metasediments derived from unlithified volcanic sources, to predominantly poorly-bedded metasediments derived largely from epiclastic volcanic material. Relatively large "lenses" of mafic metavolcanics are present throughout the Heron Bay Sequence and also along most of the northern contacts of the Pukaskwa Gneissic Complex and the Heron Bay Pluton.

Pyroxenite, lherzolite, and related gabbro have locally intruded the Playter Harbour Sequence near the western border of the map-area, and are an extension of the numerous sills that are found to the west in the Heron Bay Area (Muir 1979).

Early Precambrian granitic bodies have intruded the supracrustal rocks. The Pukaskwa Gneissic Complex occupies a large part of the southern and

TABLE 1 | TABLE OF LITHOLOGIC UNITS FOR THE HEMLO AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Bog, swamp, lake, and stream deposits, glaciolacustrine sand, fine sand, silt, clay, varved clay.

Unconformity

PRECAMBRIAN

LATE PRECAMBRIAN (PROTEROZOIC)

ALKALIC INTRUSIVE ROCKS

Biotite gabbroic lamprophyre, olivine ultramafic lamprophyre, alkalic basalt.

Intrusive Contact

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

Diabase, quartz diabase, porphyritic (plagioclase) diabase.

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

LATE FELSIC DIKES AND SILLS

Feldspar porphyry, aplite, pegmatite.

Intrusive Contact

CEDAR LAKE PLUTON

Hornblende-biotite granodiorite.

HERON BAY PLUTON

Porphyritic (microcline) biotite-hornblende granodiorite, hornblende-biotite granodiorite, porphyritic (plagioclase) biotite-hornblende granodiorite, hybrid rock.

GOWAN LAKE PLUTON

Porphyritic (microcline) biotite-hornblende quartz monzonite, biotite-hornblende quartz monzonite, hybrid rock.

PUKASKWA GNEISSIC COMPLEX

Porphyritic (plagioclase) biotite-hornblende granodiorite, porphyritic (plagioclase) biotite-hornblende trondhjemite, biotite-hornblende granodiorite, biotite-hornblende trondhjemite, hornblende-biotite quartz monzonite, hybrid rock.

METAMORPHOSED ULTRAMAFIC INTRUSIVE ROCKS

Lherzolite, dunite, peridotite, serpentinite, pyroxenite; chloritized, talcose and tremolitized varieties.

METAMORPHOSED MAFIC INTRUSIVE ROCKS

Gabbro, schistose gabbro dike.

Intrusive Contact

METAVOLCANICS AND METASEDIMENTS

METASEDIMENTS

Metasediments derived from unlithified volcanic sources:

Argillite (intermediate to felsic detritus), arkosic wacke and siltstone (mafic detritus), arkosic wacke and siltstone (intermediate to felsic detritus).

Metasediments derived from reworked material:

Arkosic wacke, mudstone (siltstone, argillite), porphyroblastic pelitic schists, migmatized wacke.

METAVOLCANICS

Intermediate to Felsic Metavolcanics

Massive flows, pillowed flows, tuff, lapilli-tuff, crystal tuff, pyroclastic breccia, tuff-breccia, migmatized tuff.

Mafic Metavolcanics

Foliated flows, amphibolitized flows, pillowed flows, variolitic flows, pyroclastic breccia, tuff-breccia, tuff, lapilli-tuff, laminated (epidote layers) volcanics, migmatized flows.

---

southeast-central parts of the map-area and consists mainly of foliated and lineated trondhjemite and lesser amounts of granodiorite with a border zone of protomylonitic trondhjemite. The Heron Bay and Cedar Lake Plutons are generally massive granodiorite bodies that are similar to each other. The Gowan Lake Pluton is composed mostly of massive to lineated quartz monzonite.

All of the Early Precambrian rocks have been intruded by Middle to Late Precambrian subalkalic diabase dikes. Late Precambrian alkalic and/or lamprophyre dikes, similar to some of those found in the Heron Bay Area (Muir 1979), have locally intruded the volcanic and sedimentary rocks.

Low grade (low temperature) regional metamorphism has affected all of the Early Precambrian rocks in the area. Locally, pelitic rocks within the granitic/sediment contact zones indicate metamorphic conditions corresponding to medium grade.

Table 1 summarizes the lithologic units that were mapped.

Early Precambrian (Archean)

METAVOLCANICS AND METASEDIMENTS

Mafic Metavolcanics

PLAYTER HARBOUR SEQUENCE

The mafic metavolcanics of the Playter Harbour Sequence have an apparent thickness of 4.8 km, and are composed of tholeiitic basalt flows. This thickness is probably exaggerated due to folding (*see* section on "Structural Geology"). The metavolcanics within about 1.0 km of the granitic contacts are commonly amphibolitized.[1] This amphibolitization is most evident at the east end of the sequence where; significant recrystallization has taken place, crystals are up to 4 mm in size, metalayering has developed to form feldspar/amphibole segregations in medium- to fine-grained rocks, and epidote layers and lenses are formed in finer grained rocks. The segregated rocks are somewhat schistose due to the presence of chlorite in the amphibole layers. Some of the epidote-layered rocks have fine- to medium-grained plagioclase porphyroblasts(?) within the relatively epidote-poor layers.

The recrystallized rocks are generally medium to coarse grained, and are moderately to strongly lineated; equigranular hornblende porphyroblasts may be present. These rocks consist of fine-grained, anhedral actinolite (45 to 50 percent) and sericitized or saussuritized plagioclase (45 to 50 percent) with epidote and minor carbonate and opaque minerals. Fine-grained mafic rocks consist primarily of anhedral and(or) euhedral hornblende (55 to 60 percent), partly sericitized, anhedral plagioclase (30 to 40 percent), with minor chlorite, biotite, epidote, carbonate, quartz, and opaque minerals. Table 2 gives the chemical composition of several samples.

Mafic tuff and lapilli-tuff are locally present within the sequence. Some of the units categorized as tuff are well-foliated to schistose. These rocks possibly are metamorphosed mafic volcanic flows that have been deformed and partly recrystallized, and resemble stretched lapilli-tuffs. The rocks are dark green on fresh and weathered surfaces, fine grained, and contain fragments that are intermediate to felsic in composition.

A somewhat peculiar mafic volcanic rock is located in several places in the Hemlo area as well as in the Heron Bay Area (Muir 1979). This rock contains aphanitic, angular to subrounded lapilli-size fragments (phenocrysts?), which are generally less than 3 cm in maximum dimension, and vary from 5 to 30 percent of the rock by volume. The matrix varies considerably in texture from

[1]The mafic rocks of the Hemlo Area are essentially all amphibolites regardless of grain size that is, they are rocks consisting mostly of amphibole and plagioclase. For the purpose of this report the term "amphibolitized" refers to crystalloblastic rocks with medium- to coarse-grained textures.

TABLE 2 CHEMICAL ANALYSES OF MAFIC METAVOLCANICS, HEMLO AREA.

SPECIMEN[a] NUMBER	1	2	3	4	5	6	7	8
SiO_2	53.9	50.0	50.2	49.5	52.9	49.1	59.5	60.6
TiO_2	1.82	1.61	0.98	1.67	1.29	1.12	0.53	0.46
Al_2O_3	14.4	14.0	14.4	13.0	14.3	15.2	16.8	16.1
Fe_2O_3[b]	14.2	16.1	12.5	17.9	15.0	14.4	5.9	4.67
MnO	0.28	0.31	0.24	0.25	0.27	0.25	0.13	0.08
MgO	3.80	4.57	5.75	4.67	3.90	6.49	3.68	3.70
CaO	7.61	9.31	11.2	8.97	8.18	9.02	5.46	5.83
Na_2O	2.86	2.39	2.71	2.01	3.06	2.67	4.27	4.30
K_2O	0.18	0.45	0.49	0.19	0.53	0.78	2.29	1.66
P_2O_5	0.12	0.09	0.09	0.12	0.08	0.09	0.24	0.19
CO_2	0.37	0.86	0.88	0.83	0.27	0.30	0.02	1.08
S	0.03	0.06	0.11	0.17	0.04	0.02	0.54	0.04
TOTAL	99.6	99.8	99.6	99.3	99.8	99.4	99.4	98.7
L.O.I.[c]	0.4	0.8	1.2	1.1	0.5	1.0	1.1	1.2
S.G.[d]	2.96	3.04	3.01	3.05	2.99	3.02	2.77	2.77
N.P.C.[e]	50.3	54.9	51.4	58.9	46.3	53.2	34.2	33.8

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	IRVINE AND BARAGAR (1971)	JENSEN (1976)
1	M36-78	Mafic volcanic (flows)	Tholeiitic basalt.	High-iron tholeiitic basalt
2	M41-78	Amphibolitized mafic volcanic rock.	Tholeiitic basalt.	High-iron tholeiitic basalt
3	M48-78	Variolitic mafic flows.	Tholeiitic basalt.	High-iron tholeiitic basalt
4	M112-78	Mafic flow.	Tholeiitic basalt.	High-iron tholeiitic basalt
5	M140A-78	Amphibolitized mafic volcanic rock.	Tholeiitic basalt.	High-iron tholeiitic basalt
6	L51-78	Mafic flow.	Tholeiitic basalt.	High-iron tholeiitic basalt
7	M136-78	Intermediate to mafic tuff.	High-alumina calc-alkalic andesite.	Calc-alkalic andesite.
8	L87-78	Intermediate tuff.	High-alumina calc-alkalic andesite.	Calc-alkalic andesite.

Footnotes

a Corresponds to numbers used in Figures 3 to 6.
b Total iron as Fe_2O_3.
c Loss on ignition.
d Specific gravity.
e Normative plagioclase composition.

Notes

i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.
iii) Major components are given as uncorrected weight percent.

locality to locality depending on the degree of amphibolitization, but the fragments (phenocrysts), even though variable in size, shape, and abundance, are distinctive enough in the author's opinion to suggest that the rock had a common mode of formation. If, as the author believes, this rock type represents a continuous stratigraphic unit, it may be possible to correlate these mafic rocks over a distance of about 40 km, and to some extent, to relate the Playter Harbour and Heron Bay Sequences (*see* section on "Structural Geology").

HERON BAY SEQUENCE

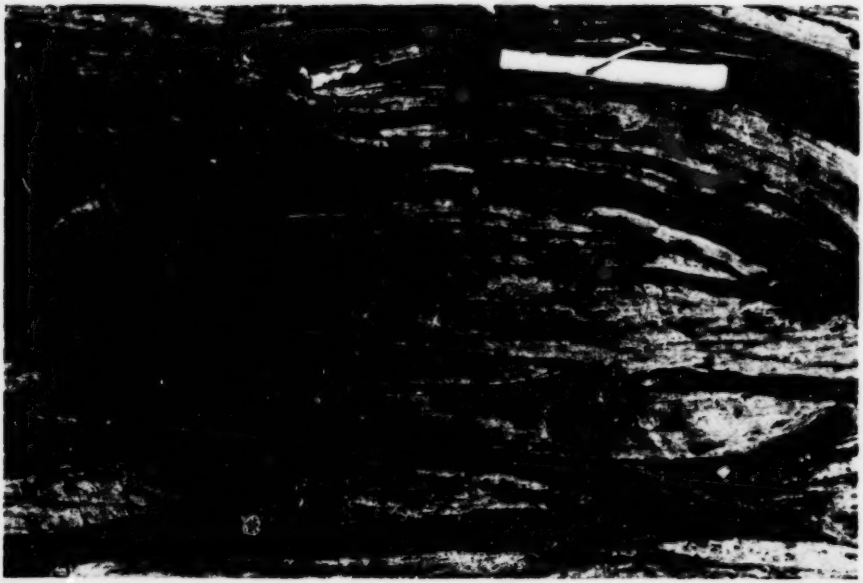
Mafic metavolcanics of the Heron Bay Sequence are more diverse than those of the Playter Harbour Sequence. The majority of these rocks are high-iron tholeiitic basalts, though minor amounts of calc-alkalic andesite were found (*see* Table 2). The tholeiitic basalt is generally fine grained, dark green, slightly lighter green on weathered surfaces, and is mildly foliated. Locally, the rock is a medium-grained amphibolite and possesses a gneissic metalayering. Both of these features are most evident along the north side of Highway 17 within 1.5 km east of the turnoff to Hemlo[1]. The southern side of this section of the highway shows fine-grained, foliated, mafic metavolcanics, some of which are pillowed; this is a distinct contrast to the northern side, just 15 m away.

Pillowed mafic volcanic rocks are present north of Rous Lake and along Highway 17 from north of Hemlo to north of the east end of Cigar Lake. North of Rous Lake, the pillows are highly stretched (Photo 1) and have selvages much darker than the interior of the pillow. Along Highway 17, most pillows are moderately to strongly stretched, medium to dark green, and variolitic. The selvages are variole-free, but the concentration of varioles increases so rapidly that generally within 3 cm of the selvage, the varioles constitute about 90 percent of the rock. Amphibolitization has commonly destroyed evidence of the varioles which closely resemble the fine- to medium-grained clots of feldspar that are formed by recrystallization. Some of the moderately amphibolitized mafic metavolcanics, up to 3 mm in grain size, have had their pillow selvages preserved as can be seen locally along Highway 17. It is not known whether the nearby amphibolitized rocks, which have no recognizable structures, were pillowed or not.

Most of the amphibolitized rocks in the Heron Bay Sequence are moderately foliated which is in contrast to many of those in the Playter Harbour Sequence that are lineated. Such rocks consist of 45 to 55 percent anhedral to subhedral amphibole, some of which shows sweeping extinction and fan-like shapes, and 40 to 45 percent anhedral, equigranular plagioclase. Minor chlorite, epidote, carbonate, sericite, sphene, and opaque minerals are commonly present. The fine-grained mafic metavolcanics have a mineralogy and mineral proportions similar to these rocks. Garnet is locally present, and is generally medium grained (1 to 3 mm), anhedral, and contains numerous, small, round quartz inclusions.

Minor mafic tuff and lapilli-tuff are present in the Heron Bay Sequence; py-

[1]Subsequent highway construction (*circa* 1979) may have concealed this feature.



OGS 10 439

Photo 1–Highly-stretched mafic pillows (tholeiitic basalt) located north-northeast of Rous Lake.

roclastic breccias are rare. The best exposure occurs northwest of Rous Lake and shows a highly stretched pyroclastic breccia (pillow breccia?) that contains mafic fragments that are more felsic than the matrix. Elsewhere, lenses of tuff up to several metres thick commonly lie within intermediate to felsic pyroclastic rocks, or within the mafic metavolcanics near the contacts with the more felsic rocks. The tuff consists primarily of fine-grained hornblende (35 to 45 percent) and plagioclase (40 to 65 percent) with minor biotite, chlorite, epidote, sphene, quartz, and opaque minerals.

The calc-alkalic andesite rocks are foliated to lineated, medium to dark greenish grey on weathered surfaces, lighter greenish grey on fresh surfaces, and generally have distinct, fine- to medium-grained (1 to 2 mm) crystals of hornblende present in an aphanitic to very fine grained, grey matrix. These rocks consist primarily of anhedral, moderately sericitized, very fine grained to fine-grained plagioclase crystals less than 0.5 mm in size (up to 80 percent), with subhedral to euhedral, fine- to medium-grained hornblende crystals less than 2 mm in size (up to 20 percent). Biotite (up to 5 percent), chlorite, epidote, carbonate, sphene, and opaque minerals are also commonly present. Even though some of these rocks can be easily confused with dacitic rocks, they are closely associated with intermediate to felsic pyroclastic rocks and may be partly composed of ejecta.

Intermediate to Felsic Metavolcanics

PLAYTER HARBOUR SEQUENCE

Intermediate to felsic flows and/or tuffs are very minor within the Playter Harbour Sequence. These rocks occur within the mafic metavolcanics as small units of fine-grained, massive to slightly foliated, grey- to buff-coloured rocks, and are not unlike some of those in the Heron Bay Sequence.

HERON BAY SEQUENCE

Intermediate to felsic metavolcanics form a large proportion of the rocks of the Heron Bay Sequence. These rocks commonly grade laterally and imperceptibly into sedimentary rocks that have similar characteristics. The aspect of this relationship is discussed in more detail in the section on metasediments.

Very fine grained, massive to mildly foliated, weakly-banded, buff to light grey rocks form a minor proportion of the metavolcanics. These rocks may be a mixture of flows and tuffs, the field criteria were not explicit, but they are commonly associated with rock definitely identified as tuff and lapilli-tuff. Locally, as in the area northeast of Rous Lake just south of the Black River, the rocks weather with a rusty stain, but no obvious explanation such as the presence of pyrite crystals, or hematite stringers was observed to account for this.

Pillowed lavas of probable intermediate composition were observed at only one locality, slightly less than 0.5 km west of the Hemlo turnoff on Highway 17. Rounded pillows are present in one exposure, and apparently are undeformed, with buff to grey weathered surfaces, thick rusty selvages, and randomly-oriented hornblende needles up to 3 mm in size. Tops could not be determined; the unit could not be traced. In thin section, the rock is seen to consist of very fine grained, anhedral plagioclase (and quartz?) (70 percent) with fine- to medium-grained, anhedral to subhedral, bluish green hornblende (15 percent) and very fine grained, ragged, pale olive brown biotite (5 percent) with minor epidote, chlorite, carbonate, and opaque minerals. The rock probably belongs to the calc-alkalic suite of rocks, and even though it is considered to be dacitic in composition (no analysis was made of it), the rock may be a calc-alkalic andesite.

The majority of the intermediate to felsic rocks consist of tuff and lapilli-tuff with minor crystal tuff. These rocks differ in appearance from locality to locality, but generally range from medium to dark greenish grey to brownish grey to beige; fresh surfaces are slightly darker than weathered ones. Bedding is generally poorly defined and discontinuous; where present, it ranges from thicknesses of 0.5 cm to 5 cm (Photo 2). In thin section, the rocks are seen to consist primarily of very fine grained partly sericitized plagioclase and quartz (up to 90 percent), with biotite or hornblende (up to 25 percent). Chlorite is commonly a minor retrograde mineral after biotite and hornblende, and epidote, muscovite, sphene, tourmaline, and opaque minerals are present in amounts usually much less than 1 percent each. Table 3 gives the chemical composition of two samples.

OGS 10 440

Photo 2–Stretched intermediate to felsic (dacitic) tuff and lapilli-tuff showing discontinuous bedding, east-northeast of Hemlo.

Pyroclastic breccia and tuff-breccia intermediate in composition are not common, and are mostly present in the area about 4.8 km north-northeast to northeast of Rous Lake. Very minor amounts of highly stretched felsic breccias (conglomerate?) were found locally within some volcanic-derived sedimentary rocks. The larger clasts in general are polymictic, subangular to subrounded, hornblende-bearing and slightly to moderately stretched. The matrix generally consists of plagioclase and hornblende with smaller fragments of a composition similar to the larger ones. At one locality, near the Black River, clasts are particularly rounded and have undergone little deformation. Blue quartz was recognized in some of the pyroclastic breccia fragments which are similar to many of those found in the Heron Bay Area (Muir 1979). These rocks in the Hemlo area may be conglomerate derived from unlithified or lithified pyroclastic breccia of a similar source as the rocks of the Heron Bay Area.

Metasediments

Most of the metasediments in the Hemlo area are considered by the author to be distal, water-deposited material derived from unlithified volcanic sources. Although this interpretation is tentative, it is based on certain field observa-

TABLE 3 CHEMICAL ANALYSES OF INTERMEDIATE TO FELSIC METAVOLCANICS, HEMLO AREA.

SPECIMEN[a] NUMBER	9	10
SiO_2	69.0	72.6
TiO_2	0.35	0.23
Al_2O_3	16.8	15.1
Fe_2O_3[b]	1.99	1.12
MnO	0.05	0.02
MgO	0.89	0.70
CaO	2.48	0.95
Na_2O	3.39	4.93
K_2O	2.90	2.73
P_2O_5	0.07	0.03
CO_2	1.01	0.27
S	<0.01	0.01
TOTAL	98.9	98.7
L.O.I.[c]	1.2	0.7
S.G.[d]	2.68	2.64
N.P.C.[e]	28.02	9.26

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	IRVINE AND BARAGAR (1971)	JENSEN (1976)
9	M163-78	Felsic to intermediate tuff.	High-alumina dacite.	Calc-alkalic rhyolite.
10	L91-78	Felsic to intermediate tuff.	Calc-alkalic rhyolite.	Calc-alkalic rhyolite.

Footnotes

a Corresponds to numbers used in Figures 3 to 6.
b Total iron as Fe_2O_3.
c Loss on ignition.
d Specific gravity.
e Normative plagioclase composition.

Notes

i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.
iii) Major components are given as uncorrected weight percent.

tions, and is an attempt to reflect the fact that the rocks are neither clearly pyroclastic nor are they clearly sedimentary in origin. The following features led to this interpretation:

1) The rocks have a similar appearance to tuff and lapilli-tuff, are mafic to felsic in composition, and are spatially adjacent to recognizable clastic sedimentary rocks;

2) The rocks commonly have thinly-laminated to thickly-laminated, continuous, bedding structures (from less than 0.3 cm to 1 cm thick);

3) The rocks are fine grained which suggests that an important sorting process was active;

4) There is a general lack of block size "pyroclastic" fragments (compare with the Heron Bay area; Muir 1979);

5) There are mixed hornblende- and biotite-bearing rocks that occur within a bed or among adjacent beds. The volcanic rocks are commonly amphibole predominant and the sedimentary rocks are commonly biotite predominant;

6) There is an almost ubiquitous lack of potassic feldspar which indicates virtually no input of material occurred from sources containing such minerals (eg. granitic rocks);

7) There is a definite similarity in chemical composition between many of these rocks and comparable pyroclastic rocks (basalt, andesite, dacite, rhyolite; (*see* section on "Petrochemistry").

Nevertheless, a consistent classification in the field was difficult due to a continuum of the features listed above beyond the generalizations that have been made. It should therefore be recognized that;

1) The units as defined on the map represent a collective summation of various observations such that a general conception of facies changes can be made without interpreting numerous units;

2) It is highly possible that some of the pyroclastic rocks may be more appropriately classified as "sedimentary rocks".

Map 2452 (back pocket) is an interpretation of actual observations made in the field. These observations indicate, despite the limited exposure in some areas and a medium grade of metamorphism, that the geology does not represent a simple set of facies changes from west to east, but rather, a number of large individual lenses or "pockets" of sedimentary rocks and mafic volcanic rocks within intermediate to felsic pyroclastic rocks in the west that change to predominantly sedimentary rocks in the east.

METASEDIMENTS DERIVED FROM UNLITHIFIED VOLCANIC SOURCES

Metasediments derived mainly from unlithified volcanic sources are difficult to describe using the standard sedimentary nomenclature. Mudstone, wacke, and arenite are not meaningful terms because the fine-grained rocks vary from mafic to felsic in composition (Table 4) due to their volcanic sources. For these sedimentary rocks, it is easier to discuss them in terms such as "mafic sediments" and "intermediate to felsic sediments".

Sedimentary rocks composed predominantly of mafic volcanic material

TABLE 4 | CHEMICAL ANALYSES OF METASEDIMENTS, HEMLO AREA.

SPECIMEN[a] NUMBER	11	12	13	14	15	16	17	18	19
SiO_2	48.8	65.5	64.7	64.1	69.6	64.8	66.1	63.7	60.8
TiO_2	0.85	0.32	0.54	0.45	0.30	0.81	0.43	0.54	0.79
Al_2O_3	16.8	17.5	19.1	16.8	16.2	15.4	16.8	17.1	18.0
Fe_2O_3[b]	11.8	2.08	3.41	3.39	2.14	8.37	2.81	5.76	7.79
MnO	0.37	0.04	0.06	0.10	0.04	0.14	0.03	0.05	0.13
MgO	4.53	0.72	1.01	1.51	1.16	2.91	0.50	2.45	3.17
CaO	13.2	3.46	2.19	3.43	2.06	2.42	2.04	2.61	1.56
Na_2O	2.32	3.89	5.17	5.07	3.36	2.73	3.56	4.42	1.25
K_2O	0.34	3.83	2.01	2.24	3.62	1.59	2.71	2.20	2.63
P_2O_5	0.13	0.06	0.16	0.25	0.11	0.11	0.12	0.16	0.12
CO_2	0.30	1.43	0.23	1.34	0.45	0.22	8.18*	0.14	1.49
S	0.01	<0.01	0.06	0.13	0.06	0.29	1.83	0.25	0.35
TOTAL	99								
TOTAL	99.5	98.8	98.6	98.8	99.1	99.8	105.1*	99.4	98.1
L.O.I.[c]	1.0	3.4	1.5	1.8	0.9	1.4	4.4	1.1	3.4
S.G.[d]	3.09	2.66	2.70	2.67	2.66	2.81	2.64	2.73	2.77
N.P.C.[e]	62.3	32.5	17.5	25.3	24.0	31.5	22.6	23.1	38.3

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	IRVINE AND BARAGAR (1971)	JENSEN (1976)
11	M25-78	Sediment (volcaniclastic mafic tuff).	High-alumina calc-alkalic basalt.	Calc-alkalic basalt.
12	M45-78	Sediment (volcaniclastic-felsic tuff).	High-alumina calc-alkalic dacite.	Calc-alkalic rhyolite.
13	M58-78	Sediment (volcaniclastic-intermediate to felsic tuff).	High-alumina calc-alkalic dacite.	Calc-alkalic rhyolite.
14	M120-78	Sediment (volcaniclastic-intermediate to felsic tuff).	High-alumina calc-alkalic dacite.	Calc-alkalic dacite.
15	M146-78	Sediment (volcaniclastic-felsic to intermediate tuff).	High-alumina calc-alkalic dacite.	Calc-alkalic rhyolite.
16	M21-78	Arkosic wacke.	Calc-alkalic andesite.	Calc-alkalic andesite.
17	M91-78	Argillite.	High-alumina calc-alkalic dacite.	Calc-alkalic rhyolite.
18	M94-78	Arkosic wacke.	High-alumina calc-alkalic dacite.	Calc-alkalic dacite.
19	L89-78	Mafic to intermediate tuff.	High-alumina calc-alkalic andesite.	Calc-alkalic andesite.

Footnotes

a Corresponds to numbers used in Figures 3 to 6.

b Total iron as Fe_2O_3.

c Loss on ignition.

d Specific gravity.

e Normative plagioclase composition.

*0.6% CO_2, 2.17% non-carbonate carbon; total with 0.6% CO_2 is 97.5%.

Notes

i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).

ii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

(mafic sedimentary rocks) are not common. The best exposure lies along Highway 17 about 1.8 km west of the Hemlo turnoff where there is a succession from south to north of rocks ranging from purplish grey arkosic wacke, to medium grey intermediate to felsic sedimentary rocks (tuff, lapilli-tuff size material), and then to mafic sedimentary rocks (lapilli-tuff, tuff-size fragments) within about 20 m. In outcrop, stretched, recrystallized, felsic lapilli up to 1 cm long, occur in an amphibole matrix which in thin section is seen to consist of very fine grained to fine-grained, elongated, subhedral, lath-shaped hornblende (55 percent), very fine grained epidote (20 percent), and very fine grained equant plagioclase.

Intermediate to felsic sedimentary rocks are commonly well bedded and laminated. Differences in the proportions of such minerals as biotite and opaque minerals account for the laminations. Variations in grain size differences, having a maximum range from very fine grained, about 0.3 mm, to fine-grained, 1 mm, are commonly minimal. Some of the weathered surfaces reveal poorly-defined beds 0.3 to 1.0 cm thick. These are slightly evident in sawn surfaces and are virtually not detectable in thin section. Dark brown to green weathering, fine-grained, randomly-oriented porphyroblasts up to 1 mm in size are common in many of the more felsic sedimentary rocks. The more brownish porphyroblasts are garnet, partly retrograded to chlorite, and the greenish porphyroblasts are poikiloblastic, pale green amphibole and/or clumps of ragged brownish-green chlorite.

Examination of the thin sections reveals that the intermediate to felsic sedimentary rocks have a common mineralogy. Partly-sericitized plagioclase and lesser amounts of quartz are generally very fine grained and anhedral (60 to 90 percent). Muscovite is commonly present (from 5 percent to 20 percent). Biotite is generally present (about 5 percent). Chlorite is minor in most cases, but may be present up to as much as 30 percent. Opaque minerals are present up to 1 percent. Other minor minerals present in some of the rocks are carbonate, epidote, garnet, amphibole, tourmaline (schorlite), and microcline.

METASEDIMENTS DERIVED FROM REWORKED MATERIAL

The reworked sedimentary rocks can be divided into two groups; namely mudstone and wacke. The mudstone is argillitic, but is likely to have been originally siltstone. Wacke is feldspathic and can be designated as a lithic arkosic wacke (Table 4). These reworked sedimentary rocks are not common in the western part of the map-area. The best-exposed rocks (wacke) occur on Highway 17 east of Rous Lake. The small units, or "lenses" of sediments become more numerous to the east and more variable in the type of sediment. Further east, the sedimentary rocks rapidly become the major constituent of the supracrustal rocks and consist mostly of monotonous, grey, poorly-bedded wacke with lesser amounts of well-bedded wacke and siltstone. The contact zones of the granitic plutons have played an important part in producing indicative metamorphic mineral assemblages in the more pelitic units (*see* section on "Metamorphism").

The argillite forms relatively thin units, less than 4 m thick, and is gener-

ally traceable for much less than 0.3 km. Detectable differences in grain size and colour, which reflect changes in mineralogy, cause the general appearance of the rock to vary from locality to locality. The argillite is commonly black, but dark grey and brownish grey varieties are present. Rusty staining is ubiquitous on weathered and cleaved surfaces, and is locally due to pyrite. In the black varieties, very fine grained plagioclase and quartz (0.03 mm) constitute 70 percent to 85 percent of the rock by volume. Opaque minerals are very fine grained, account for the dark colour, and constitute 15 to 20 percent of the rock. Muscovite is present up to 7 percent. Non-carbonate carbon is also present (*see* Table 4). The lighter varieties, generally siltstone, consist of interlocking plagioclase and quartz (75 to 85 percent), biotite (15 to 25 percent), minor opaque minerals, and in one case, tourmaline.

Thickly-laminated, magnetite-bearing siltstone is present in two outcrops (*see* Map 2452, back pocket). Fine-grained, anhedral to euhedral magnetite may only form as much as 10 percent in individual beds, but it imparts a characteristic dark grey colour to those beds and easily attracts a hand magnet. The matrix of the magnetite-bearing beds and adjacent beds is silt-size, up to fine sand-size, and consists of quartz and plagioclase (85 percent) and up to 15 percent olive-green biotite in flakes less than 0.05 mm in maximum dimension.

Arkosic wacke in the western part of the area has a greater component of mud material in the matrix than arkosic wacke in the east. The rocks near the Heron Bay Pluton, east-northeast of Rous Lake, have locally been moderately migmatized. The rocks are medium grey, very thinly bedded (1 to 3 cm), deformed with boudinaged felsic injected material, and locally display a secondary schistosity at an angle to the bedding in the more argillaceous layers (Photo 3). Very fine grained to fine-grained interlocking quartz and partly sericitized plagioclase constitute 70 to 75 percent of these sedimentary rocks. Brown biotite forms as much as 20 percent of the rock. Garnet locally forms as much as 4 percent, chlorite forms 2 percent, and opaque minerals form 2 percent of the rock.

In the eastern quarter of the Hemlo area where arkosic wacke becomes predominant, the sedimentary rocks are poorly bedded for the most part and are medium to light grey. Quartz and plagioclase are anhedral and interlocking, and constitute 85 percent to 90 percent of the rock. Biotite constitutes 10 to 15 percent. Chlorite and opaque minerals are present in very small amounts.

Locally, the pelitic rocks have been highly recrystallized, and bedding may be only partly preserved. Porphyroblasts of garnet, andalusite, staurolite, cordierite, or clumps of sillimanite (fibrolite) are locally present. Retrograde metamorphism has destroyed many of these porphyroblasts. Bulk rock composition, however, was important in determining which rocks developed these indicator minerals. These minerals are rare, probably because the majority of the sedimentary rocks in the area are texturally too mature; the rocks had too small a mud matrix component to have a composition conducive to the formation of these indicator minerals.

One of the best locations to find porphyroblasts is at an outcrop on the major bend in Highway 17 near the eastern border of the map-area. Garnet-muscovite-biotite schist (Photo 4) with euhedral garnet and elongated, wedge-shaped quartz polygons is present. Garnet-anthophyllite-biotite schist (Photo 5) containing medium- to coarse-grained anthophyllite is also present. Staurolite was identified in the outcrop. Anthophyllite, staurolite, and garnet are re-

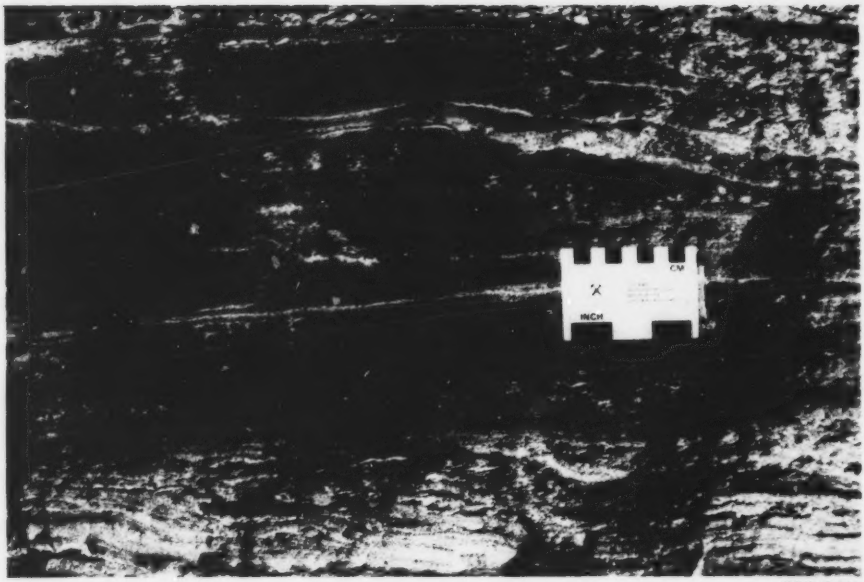


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Photo 3–Sedimentary rocks derived from reworked material showing continuous bedding and cleavage not parallel to bedding. Highway 17, east of Rous Lake.

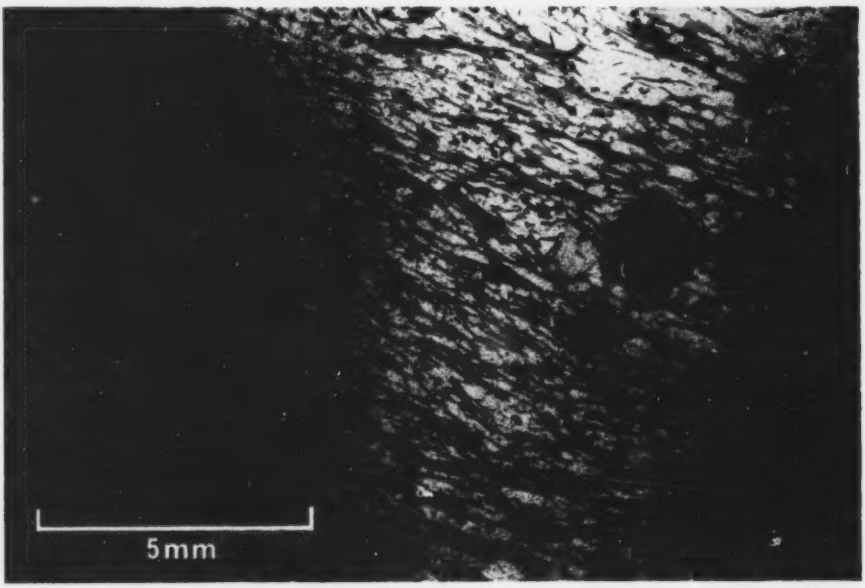

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Photo 4–Photomicrograph of garnet-muscovite-biotite schist showing euhedral garnets in recrystallized matrix of quartz and biotite. Highway 17, east end. Bar scale represents 5 mm.

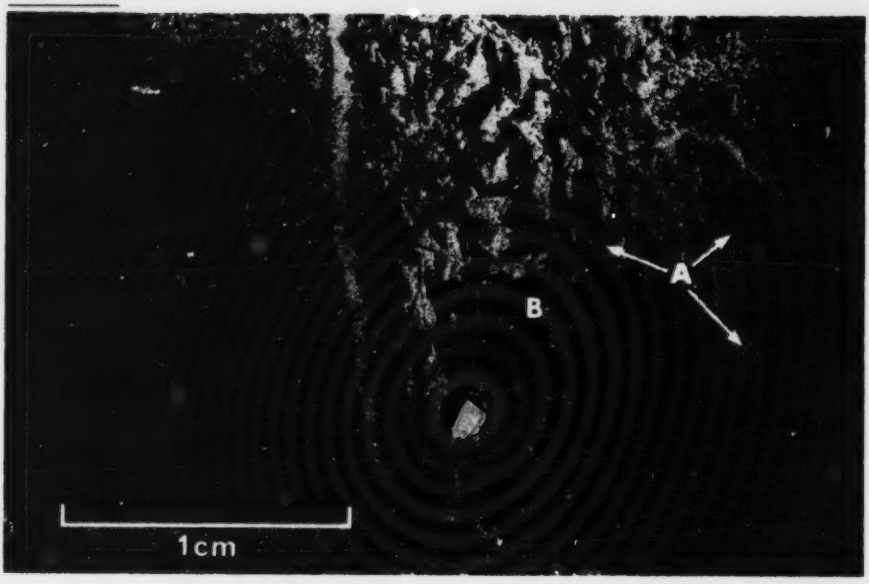

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Photo 5–Photomicrograph of garnet-anthophyllite-biotite schist (bed on right; laths are anthophyllite (A), equant crystal is garnet (B)), and garnet-muscovite-biotite schist (bed on left). Highway 17, east end. Bar scale represents 1 cm.

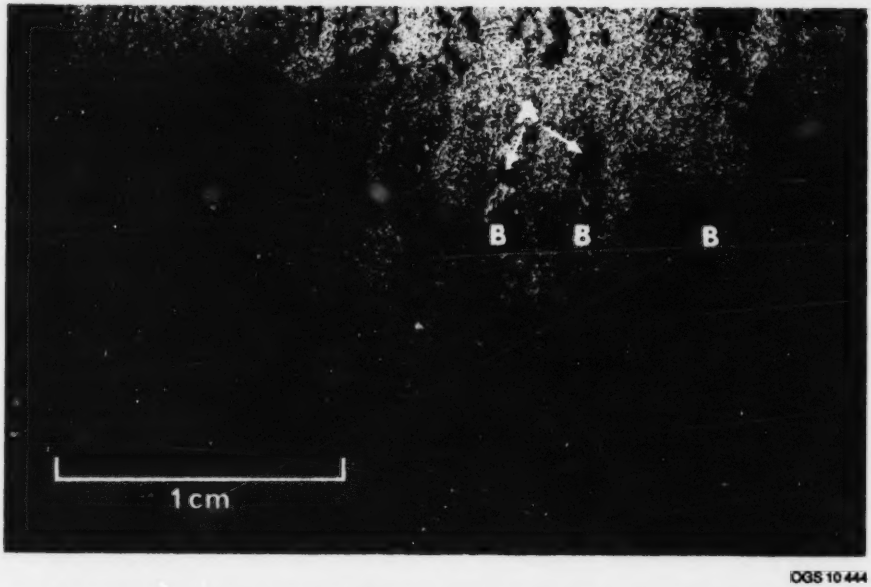

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Photo 6–Photomicrograph of sillimanite-andalusite-cordierite-biotite schist; dark grey is sillimanite (fibrolite (A)) partly surrounding cordierite porphyroblasts retrograded to pinite (B). Poikiloblastic andalusite not detectable in photograph. Northwest part of area. Bar scale represents 1 cm.

stricted to specific beds. These rocks have undergone little or no retrograde metamorphism. In the pelitic rocks, garnet-staurolite-biotite schist and sillimanite-andalusite-cordierite-biotite schist (Photo 6) locally occur within about 1.8 km of the Gowan Lake Pluton contact. In the first-mentioned schist complete retrogressive alteration of the euhedral, cross-twinned staurolite to sericite has taken place. In the second-mentioned schist, cordierite has completely retrograded to pinite which consists mainly of chlorite and sericite in this example. Andalusite is anhedral and poikiloblastic; sillimanite has tended to form around the cordierite porphyroblasts along the sides that are approximately parallel to the foliation.

METAMORPHOSED MAFIC INTRUSIVE ROCKS

The majority of the mafic and ultramafic intrusive rocks were emplaced within the Playter Harbour Sequence. Field and petrochemical evidence suggests that these intrusive rocks are comagmatic with the Playter Harbour Sequence. The gabbro is medium to coarse grained; some of the mafic laths attain lengths of up to 15 mm. The felsic component varies from 10 to 60 percent; low amounts such as 10 percent suggest that the gabbro grades mineralogically into the pyroxenite (Ontario Geological Survey nomenclature), but field evidence for this relationship was not obtained. The gabbro consists of medium- to coarse-grained, twinned, anhedral plagioclase laths that have irregular edges due to the development of hornblende. Hornblende forms 40 to 70 percent of the rock, and occurs as very fine grained to medium-grained needles and ragged laths scattered throughout the rock between the larger plagioclase crystals. Opaque minerals are present as very fine grained to fine grained, anhedral, irregularly distributed crystals (up to 2 percent), and locally have formed peculiar patterns similar to those in the pyroxenite. Minor amounts of epidote, chlorite, carbonate, and biotite are present.

Locally within the southwestern part of the Playter Harbour Sequence, medium- to coarse-grained gabbro with equigranular hornblende porphyroblasts(?) is intercalated with mafic flows. Field relationships did not reveal conclusive evidence about the intrusive nature of the rock, but contacts of the gabbro with adjacent rock are fairly sharp. The same relationships and rock types are present within 1.5 km of the eastern border of the Heron Bay area. The gabbro consists of anhedral, ragged hornblende crystals (about 40 percent) and sericitized and saussuritized anhedral plagioclase crystals (55 to 60 percent). Very fine grained hornblende is distributed throughout. Fine-grained epidote, which is probably a product of saussuritization, accounts for 2 percent of the rock. Opaque minerals are minor.

A few fine-grained, schistose mafic dikes were located in the area. These contain altered, subangular to angular fragments 0.5 cm to 4 cm in size which are mafic to intermediate in composition. These dikes are similar to some of the schistose intrusive breccia dikes found in the Heron Bay area. Many of the fragments consist mainly of amphibole and biotite, whereas the matrix consists of plagioclase and quartz (50 percent) and hornblende (45 percent). An unusual dark green, very fine grained slightly schistose dike was found on Highway 17

about 1.2 km east of Cigar Lake and is spatially related to a sheared ultramafic schist. Both of these rocks may be related to an east-trending fault zone. Although this dike was mapped as an ultramafic rock, its composition is defined as that of a tholeiitic picrite basalt (Table 5) and is shown on the map (Map 2452, back pocket) as a schistose gabbro dike.

METAMORPHOSED ULTRAMAFIC INTRUSIVE ROCKS

Massive ultramafic rocks have intruded the Playter Harbour Sequence volcanic rocks near the southwest border of the map-area. The rocks can be divided into two general types; peridotite and pyroxenite.

The peridotite consists of lherzolite, which approaches a dunitic composition, and serpentinite which is fine-grained and altered to such an extent as to preclude a more specific terminology. For many outcrops, the rock was classified as fine-grained serpentinite; weathered surfaces are rusty orange-brown, and fresh surfaces are dark green-black. In thin section, mesh-textured serpentine, some of which can be seen to pseudomorph olivine, forms approximately 65 percent of the rock. Fine-grained tremolite and(or) pyroxene forms the matrix along with 4 percent opaque minerals. Talc and chlorite are minor.

In some cases, the weathered surfaces have knobs or mineral clots about 1 cm in diameter. These could be the result of differential weathering of phenocrysts (pyroxene?) or a metamorphic feature of some type. In some outcrops, examination of partly weathered surfaces revealed light greyish green serpentinized olivine as equant, 2 to 3 mm crystals (80 percent) in a dark green-black matrix. In thin section, the matrix consists of tremolite, remnant clinopyroxene, and abundant magnetite (4 percent). The magnetite formed as disseminations throughout and concentrations along cleavage planes in clinopyroxene and fracture fillings in olivine.

Pyroxenite is variable in appearance. The rock is generally dark, blackish green, and the grain size ranges from 1 to 6 mm. Plagioclase forms less than 1 percent to rarely as much as 10 percent of the rock. The rock consists almost entirely of subhedral crystals of pyroxene which show very minor to complete alteration to hornblende. Accessory minerals include opaque minerals, chlorite, muscovite/talc, carbonate, and epidote. Some examples of partial uralitization were observed in thin sections and these show hornblende rimming clinopyroxene and filling fractures. No evidence of remnant pyroxene was observed in similar rocks to the west in the Heron Bay area. Thus, the Hemlo area pyroxenite provides the only evidence to distinguish the pyroxenite from hornblendite in the original sense. The pyroxenite (Table 6) lies compositionally between the average alkali pyroxenite and hornblendite of Nockolds (1954).

TABLE 5 CHEMICAL ANALYSES OF METAMORPHOSED MAFIC INTRUSIVE ROCKS, HEMLO AREA.

SPECIMEN[a] NUMBER	20	21	22	23
SiO_2	52.7	45.2	48.2	48.1
TiO_2	0.86	0.58	2.07	0.78
Al_2O_3	13.5	10.5	15.1	16.5
Fe_2O_3[b]	9.46	12.5	17.7	11.3
MnO	0.18	0.19	0.25	0.20
MgO	7.80	16.5	3.11	7.43
CaO	8.48	8.91	7.05	9.39
Na_2O	2.85	1.16	5.61	3.01
K_2O	1.69	0.38	0.42	1.11
P_2O_5	0.32	0.02	0.26	0.08
CO_2	1.04	0.62	0.27	0.36
S	< 0.01	0.02	0.15	0.13
TOTAL	98.9	96.6	100.2	98.4
L.O.I.[c]	1.6	3.5	0.4	1.8
S.G.[d]	2.91	3.02	3.02	2.99
N.P.C.[e]	42.7	68.2	22.7	51.1

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	IRVINE AND BARAGAR (1971)	JENSEN (1976)
20	M44-78	Schistose gabbroic dike.	Calc-alkalic basalt.	High-magnesium tholeiitic basalt.
21	M63-78	Schistose ultramafic dike.	Tholeiitic picrite basalt.	Komatiitic basalt.
22	M97-78	Gabbro (related to pyroxenite).	Hawaiite, sodic alkali basalt series.	Alkalic — does not apply.
23	M113-78	Gabbro.	High-alumina calc-alkalic basalt.	High-magnesium tholeiitic basalt.

Footnotes
a Corresponds to numbers used in Figures 3 to 6.
b Total iron as Fe_2O_3.
c Loss on ignition.
d Specific gravity.
e Normative plagioclase composition.

Notes
i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Major components are given as uncorrected weight percent.
iii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

TABLE 6 CHEMICAL ANALYSES OF METAMORPHOSED ULTRAMAFIC ROCKS, HEMLO AREA.

SPECIMEN[a] NUMBER	24	25	26	27	28
SiO_2	45.5	43.7	46.3	36.3	36.2
TiO_2	0.40	2.35	1.15	0.89	0.65
Al_2O_3	7.68	5.78	4.86	3.50	2.79
Fe_2O_3[b]	11.0	18.9	13.5	20.8	22.7
MnO	0.19	0.23	0.22	0.27	0.28
MgO	22.2	9.72	15.5	26.0	27.4
CaO	8.04	14.6	15.7	4.67	2.84
Na_2O	0.00	1.10	0.45	0.00	0.00
K_2O	0.00	0.98	0.04	0.00	0.00
P_2O_5	0.01	0.09	0.05	0.04	0.01
CO_2	0.42	1.48	0.75	1.79	1.02
S	0.03	0.06	0.09	0.09	0.05
TOTAL	95.5	99.0	98.6	94.4	93.9
L.O.I.[c]	5.3	1.7	1.8	7.9	8.0
S.G.[d]	2.97	3.25	3.22	2.97	2.93
N.P.C.[e]	99.6	44.6	73.4	99.1	98.8

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	BY COLOUR	JENSEN (1976)
24	M46-78	Schistose ultramafic dike.	Ultramafic.	Komatiitic peridotite.
25	M101-78	Pyroxenite (coarse grained).	Ultramafic.	Alkalic — does not apply.
26	M102-78	Pyroxenite (medium grained).	Ultramafic.	Komatiitic basalt.
27	M103-78	Serpentinized peridotite.	Ultramafic.	Komatiitic peridotite.
28	M105-78	Lherzolite (dunite?).	Ultramafic.	Komatiitic peridotite.

Footnotes

a Corresponds to numbers used in Figures 3 to 6.
b Total iron as Fe_2O_3.
c Loss on ignition.
d Specific gravity.
e Normative plagioclase composition.

Notes

i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Major components are given as uncorrected weight percent.
iii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

Several dikes consisting mainly of various proportions of very fine grained chlorite, tremolite, and talc are sporadically located along or near Highway 17 for almost 4 km. They have intruded at approximately the same stratigraphic horizon between mafic metavolcanics and volcanic-derived metasediments. To the west of the microwave tower near the Hemlo turnoff, some of the dikes have intruded the mafic metavolcanics. The dikes are locally sheared and very schistose. Smooth, rounded, glaciated surfaces are common due to the softness of the rock. Table 6 gives an analysis of one of the specimens. An isolated northwest-striking 5 m thick sill of pyroxenite is located within the metasediments on Highway 17 west of Cedar Creek. The rock is medium grained, black, and similar to the medium-grained dark green-black pyroxenite within the Playter Harbour Sequence.

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

Pukaskwa Gneissic Complex

A large part of the southern part of the Hemlo Area is underlain by the Pukaskwa Gneissic Complex which extends southward for a long distance and separates the supracrustal rocks of the Heron Bay area from the Wawa Belt. The mafic metavolcanics which border the complex in the map-area are commonly amphibolitized and are medium grained. Within the map-area, the granitic rocks vary from foliated and lineated trondhjemite, the most common rock, to granodiorite and minor amounts of quartz monzonite. All have been cut by later pegmatite and aplite dikes. Locally, wisps of more mafic material occur as diffuse lenses and strips. Mapping revealed that no significant pattern in the distribution of these rock types was discernable, except that in general, areas seemed to be predominantly composed of one type or another.

The margin of the complex, within a zone which is as much as 1.5 km wide, is generally composed of plagioclase-porphyritic, protomylonitic trondhjemite. The phenocrysts approach an augen structure, and biotite and hornblende are moderately foliated (Photo 7). In general, the rocks are more mafic than interior ones, but this impression is enhanced because of the "smearing" of fine-grained mafic minerals. Well-developed gneissosity is rare. Locally, quartz crystals have been strung out, flattened to less than 1 mm thick, and recrystallized to form "ribbons" up to 5 cm long, separated by quartzofeldspathic minerals.

In thin section, partly sericitized or saussuritized plagioclase laths and minor recrystallized quartz phenocrysts lie in a very fine to fine-grained matrix of anhedral, granoblastic-polygonal plagioclase, quartz, and minor microcline. The larger plagioclase crystals are faintly zoned and weakly twinned. Anorthite composition varies from rock to rock from about An_{18} to An_{22} as determined by the Michel-Levy method. Green to olive-brown biotite and green hornblende are mostly fine to very fine grained and are generally anhedral. Chlorite is commonly present in minor amounts, generally after biotite. Foliation is more of a macroscopic feature. Alignment of minerals is not always well displayed in

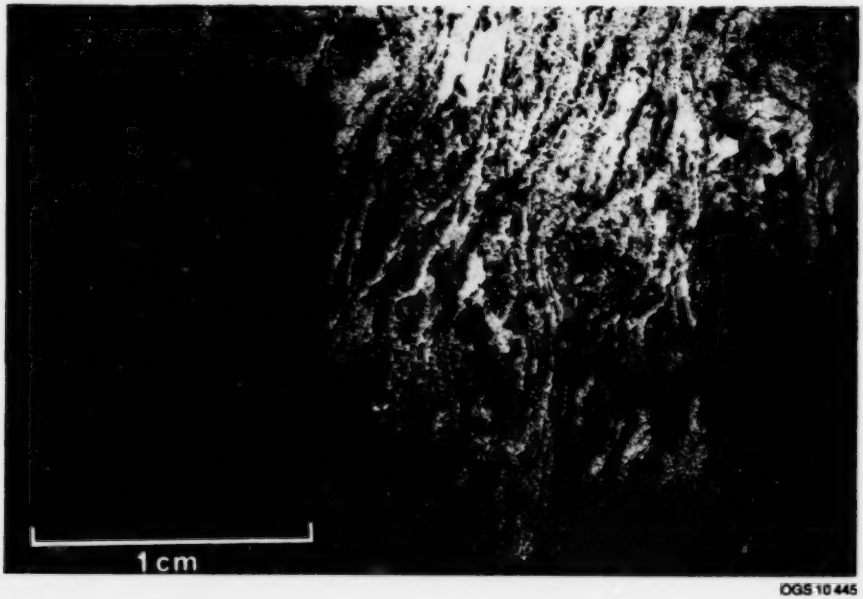

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Photo 7–Photomicrograph of plagioclase-porphyritic biotite-hornblende trondhjemite showing foliation deformed around phenocrysts and crystal clumps; matrix has fine-grained granoblastic-polygonal texture. Pukaskwa Gneissic Complex. Bar Scale represents 1 cm.

thin section and a schistosity has not developed. Colour index varies considerably from outcrop to outcrop from 5 to 25 as does the hornblende:biotite ratio. This ratio is commonly about 0.67 to 1.5, and may reach as high as 19 in rocks with a high colour index. Minor minerals commonly include sericite, epidote, opaque minerals, apatite, sphene, and allanite. Myrmekitic texture is minor.

Toward the interior of the complex the rocks grade into more felsic, moderately to poorly-foliated, non-cataclastic trondhjemite (Table 7) that locally was found to have lineated mafic minerals. The lineation is commonly difficult to detect where plunges are steep. Locally, the rocks are more potassic than trondhjemite. Microcline constitutes more than one eighth of the total feldspar and the rocks have been termed granodiorite (see Ayres 1972), although the remaining mineralogy is similar to that described for the margin of the complex.

The field evidence does not indicate more than one discrete phase exists. The rigidity of the classification scheme used in the field cannot account for the overall heterogeneity of the rock-forming materials. The rocks are very diverse in appearance; therefore, the distribution of rock types on the geological map

TABLE 7 CHEMICAL ANALYSES OF INTERMEDIATE TO FELSIC INTRUSIVE ROCKS, HEMLO AREA.

SPECIMEN[a] NUMBER	29	30	31	32	33	34	35	36	37
SiO_2	70.3	67.0	57.6	60.5	66.8	66.9	68.0	63.9	56.7
TiO_2	0.27	0.39	0.58	0.56	0.39	0.32	0.34	0.46	0.61
Al_2O_3	16.3	17.9	16.9	17.7	17.6	17.5	17.5	16.6	18.5
Fe_2O_3[b]	2.70	2.92	6.67	5.90	2.79	2.41	1.97	2.98	4.83
MnO	0.05	0.04	0.12	0.10	0.04	0.04	0.03	0.08	0.08
MgO	0.60	1.03	4.35	2.92	1.15	1.00	0.57	1.97	2.80
CaO	2.66	3.62	5.57	4.37	3.05	2.75	2.24	2.23	4.69
Na_2O	5.14	5.99	4.33	4.78	5.61	5.97	5.81	6.44	6.51
K_2O	1.38	1.22	2.71	2.82	2.41	2.34	2.65	2.64	1.99
P_2O_5	0.04	0.11	0.31	0.28	0.15	0.09	0.09	0.16	0.31
CO_2	0.10	0.10	0.22	0.10	0.09	0.15	0.14	1.26	1.86
S	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.23	0.34
TOTAL	99.5	100.3	99.4	100.0	100.01	99.5	99.3	99.0	99.2
L.O.I.[c]	0.5	0.4	1.0	0.8	0.4	0.6	0.4	1.8	2.5
S.G.[d]	2.68	2.70	—	—	2.67	2.69	2.66	2.67	2.69
N.P.C.[e]	21.9	24.3	—	—	21.9	19.6	16.8	12.9	20.8

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	After AYRES (1972) (normative)	
29	M139-78	Quartz diorite.	Trondhjemite.	Pukaskwa Gneissic
30	L16-78	Quartz diorite.	Trondhjemite.	Complex.
31	M324-78	(Quartz) Monzonite	Diorite**.	Gowan Lake
32	L280-78	Quartz Monzonite (porphyritic).	Diorite**.	Pluton.
33	M13-78	Granodiorite.	Granodiorite.	Heron Bay Pluton.
34	L72-78	Granodiorite.	Granodiorite.	
35	M109-78	Granodiorite.	Granodiorite.	Cedar Lake Pluton.
36	M29-78	Feldspar porphyry.	High-alumina calc-alkalic dacite.*	
37	M47-78	Dioritic dike.	(Oligoclase) Syenodiorite.	

Footnotes

a Corresponds to numbers used in Figures 3 to 6.
b Total iron as Fe_2O_3.
c Loss on ignition.
d Specific gravity.
e Normative plagioclase composition.
*Irvine and Baragar (1971) classification.
**See text for explanation.

Notes

i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Major components given as uncorrected weight percent.
iii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

(Map 2452, back pocket) reflects generalizations based on textures, mineralogy, petrography, and a few supportive chemical analyses.

Large xenoliths and pendants are locally present in the complex; these can be seen along the shoreline of Herrick Lake and further to the southeast. Detailed mapping was not undertaken here, but outcrops show that migmatized mafic and felsic metavolcanics, and possibly migmatized metasediments have been incorporated into the granitic rocks. In extreme cases, assimilation and dispersion of mineral components have left only wisps of foliated granitized rocks within the "host" rock. It is possible, in the writer's opinion, that the Pukaskwa Gneissic Complex represents older sialic crust (*see* section on "Structure").

Gowan Lake Pluton

The Gowan Lake Pluton consists of at least two phases of quartz monzonite. These are: a) medium- to coarse-grained, weakly-lineated, microcline porphyritic, biotite-hornblende quartz monzonite (Table 7), and b) fine- to medium-grained, massive, equigranular, biotite-hornblende quartz monzonite. Although a few contacts between the two phases were seen in the field, it was not determined which of the two is the older. Some of the outcrops consist of non-porphyritic, quartz-poor quartz monzonite to granodiorite (*see* Table 7) that texturally and mineralogically is similar to the porphyritic phase described above. Its classification as a separate phase was not established by the author.

It should be noted here that normatively the rocks are classed as diorite, whereas modally, many of them are quartz monzonite. All other plutons have similar modes consistent with their norms. This large discrepancy in the case of the Gowan Lake Pluton stems from the fact that there is generally less quartz and microcline, and significantly more hornblende than in the average quartz monzonite. Hence, calcium in hornblende was used in the normative calculations to produce plagioclase that was too calcic, and diopside was also produced which used up silica. In one sample, quartz is 11 percent, and microcline is 35 percent of total feldspar (modally); both of these criteria barely classify the rock as quartz monzonite according to the classification of Ayres (1972). Some of the rocks have less than 10 percent quartz, for the sake of simplicity, the term quartz monzonite has been maintained.

The porphyritic phase contains randomly-oriented, Carlsbad-twinned, microcline phenocrysts (4 mm to 15 mm) that contain a few inclusions of all other minerals (compare with the Heron Bay Pluton, Muir 1979). Bluish green, subhedral to euhedral, fine- to coarse-grained prisms and laths of hornblende (16 percent) are somewhat preferentially oriented probably due to flow alignment of the crystals in the magma (Photo 8). The "matrix" consists of plagioclase, quartz, biotite, and minor microcline. Plagioclase, An_{26} to An_{28} (Michel Levy method), occurs as subhedral laths, and has been moderately to severely sericitized. Quartz is anhedral and strained, and microcline is anhedral. Biotite occurs as brownish green, anhedral, 1 to 3 mm flakes (6 percent) that contain small zircon crystals. Hornblende:biotite ratios range from about 1.5 to 9. Minor minerals include epidote, sphene, allanite, and opaque minerals.

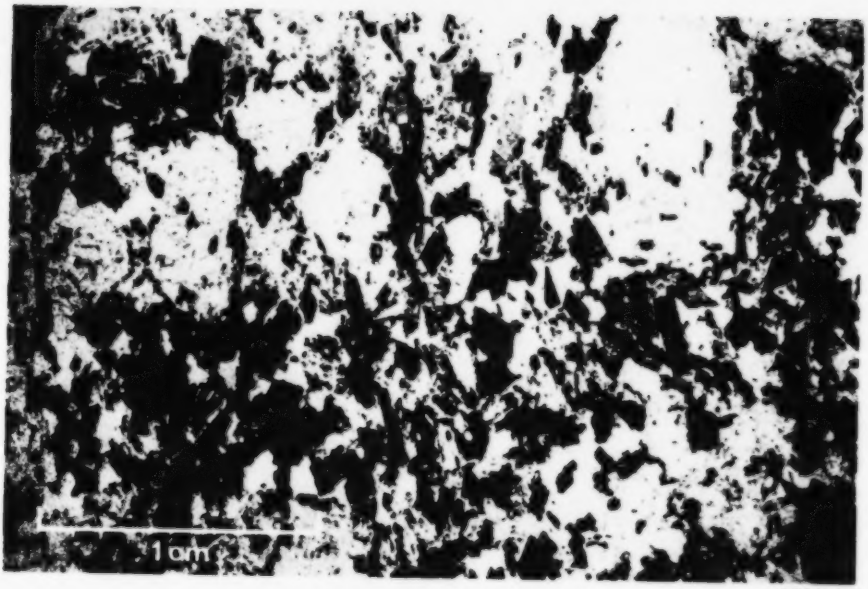

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Photo 8–Photomicrograph of microcline-porphyritic biotite-hornblende quartz monzonite showing weak lineation of hornblende laths. Gowan Lake Pluton.

The finer grained, non-porphyritic phase consists of anhedral, relatively equigranular plagioclase (selectively heavily sericitized), strained quartz, and microcline, as well as slightly finer grained, dull green hornblende, brown biotite, and chlorite. Chlorite has replaced a large proportion of the biotite. Quartz and biotite (chlorite) are slightly more abundant than in the porphyritic phase. Minor minerals are epidote, sphene, apatite, and opaque minerals. Myrmekitic texture is rare.

Small, recrystallized (amphibolitized) mafic xenoliths are common throughout the pluton.

Heron Bay Pluton

The Heron Bay Pluton consists predominantly of massive, medium-grained, equigranular, hornblende-biotite granodiorite. Plagioclase ranges in grain size from 0.5 to 3 mm, averages about 1 mm in length, and forms subhedral, partly to moderately sericitized, twinned, and weakly-zoned crystals ranging from An_{18} to An_{22} (Michel Levy method). Quartz is anhedral, and is also similar to microcline in grain size. Hornblende is bluish green to green, an-

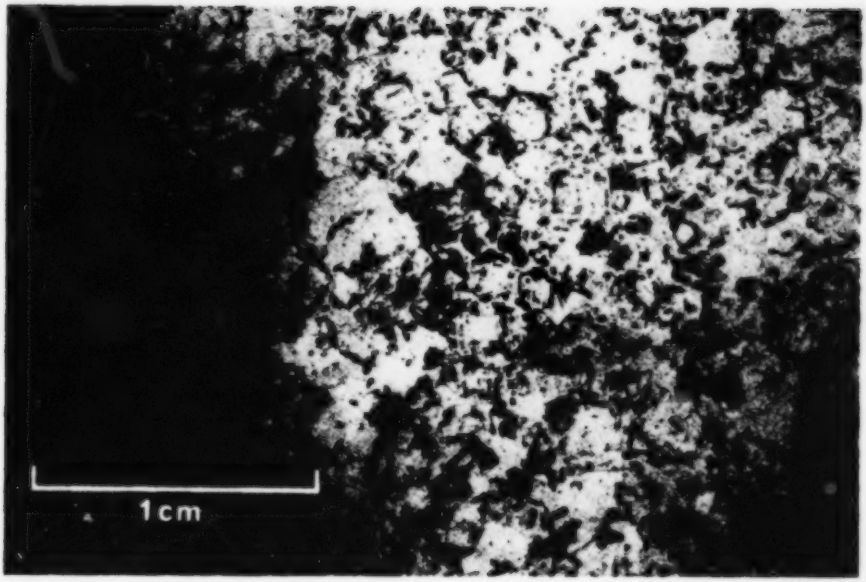

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Photo 9–Photomicrograph of massive, hornblende-biotite granodiorite showing partly-altered, zoned, plagioclase crystals. Heron Bay Pluton.

hedral, and is slightly finer grained than the felsic minerals. Biotite is brownish green to green, anhedral, and is also similar to the felsic minerals in grain size (Photo 9). The hornblende: biotite ratio generally ranges from 0.67 to 1.5. Minor minerals include epidote, sphene, chlorite, apatite, allanite, and opaque minerals. Myrmekitic texture is minor in percent abundance but common.

Contacts of phases were not observed. The granodiorite has, however, locally developed poorly formed microcline megacrysts which are visible on weathered surfaces. The megacrysts form anhedral "blobs" up to 20 mm in maximum dimension and contain numerous inclusions of all other minerals. Some have approached shapes that suggest subhedral phenocrysts. This is also evident in other samples of granodiorite, which upon staining revealed 2 to 4 mm "blobs" of inclusion-laden microcline. The study of numerous stained samples has revealed that there may be a continuum between equigranular and porphyritic granodiorite.

Granitic dikes have intruded the supracrustal rocks near the contacts of the pluton, and virtually all the dikes have a well-developed porphyritic texture. Some of the granodiorite is weakly to moderately plagioclase-porphyritic and occurs in a zone within about 1 km of the pluton's contacts, especially along the southeast contact that is separated from the Pukaskwa Gneissic Complex by a thin "strip" of mafic metavolcanics. The porphyritic and equigranular gra-

nodiorites in this area have developed a weak foliation which, in outcrops very close to the Pukaskwa Gneissic Complex, makes it difficult to distinguish between the two granitic bodies. The contact between the two, especially about midway between Cache and Mussy Lakes, is largely interpretive.

Inclusions up to 10 cm in size, though sparse, are present throughout the pluton. Furthermore, large rafts of mafic and intermediate to felsic metavolcanics, some of which are deformed on a large scale, for example north of Campfire Lake, are particularly common within 1.5 km of the outer contacts of the pluton. Compared to the Pukaskwa Gneissic Complex, only a minor proportion of the mafic metavolcanics are amphibolitized.

Cedar Lake Pluton

The Cedar Lake Pluton is a poorly-exposed body of hornblende-biotite granodiorite (*see* Table 7) in the northeast corner of the area that extends much further to the east (Ontario Department of Mines 1972). It is very similar to the massive, equigranular granodiorite of the Heron Bay Pluton. Plagioclase forms subhedral, twinned, weakly-zoned, and mildly sericitized laths. Quartz forms anhedral, equant, slightly strained crystals. Microcline occurs as anhedral, irregularly shaped crystals. All these minerals are 1 to 3 mm in size. Biotite is less than 1 mm in size, displays brownish green to green pleochroism, and is anhedral. Hornblende is of a similar size, displays blue-green to green pleochroism and is anhedral. Minor minerals include epidote, sphene, apatite, allanite, opaque minerals, and possibly zircon. Myrmekitic texture is common but minor.

Late Felsic Dikes and Sills

Feldspar porphyry dikes are locally common in the metavolcanics and metasediments. The differences among them are too numerous to fully describe. Attempts to consistently separate synvolcanic porphyries from later porphyritic dikes related to the granitic plutons were not entirely successful. Some generalizations, however, can be made. Subvolcanic porphyries commonly have plagioclase phenocrysts in an aphanitic, medium to light grey, well-foliated matrix. Dikes related to the granitic plutons commonly have anhedral to subhedral plagioclase phenocrysts in a fine to very fine grained (phaneritic), slightly foliated matrix. Plagioclase has been partly altered to hematite. Mafic minerals are commonly chloritized. Quartz phenocrysts may be present in either porphyritic type, but are less common in the subvolcanic dikes. A complete gradation among the above descriptive characteristics may reflect a continuum of mode of formation during the development and deformation of the greenstone belt.

The subvolcanic dikes that were thin sectioned consist of plagioclase phenocrysts (10 to 35 percent) and minor to rare quartz phenocrysts in a fine-grained groundmass of plagioclase and quartz (up to 85 percent) with biotite (up to 10 percent), muscovite (up to 2 percent), epidote (up to 4 percent), and mi-

nor chlorite, carbonate, opaque minerals, sphene, and in one case allanite and grunerite. One analysis is given in Table 7.

Only a few dikes and sills are large enough to show on the map; these lie about 0.7 km north and north-northeast of the east end of Cigar Lake. Other reports of porphyritic dikes are found in the Assessment Files Research Office, Ontario Geological Survey, Toronto, relating to various property work where very detailed mapping, stripping, and(or) diamond drilling has taken place. In some cases, these dikes are related to gold mineralization (*see* section on "Economic Geology").

An equigranular, fine-grained, gray, dioritic dike that intrudes mafic metavolcanics was sampled and thin-sectioned. It was found to consist of fine-grained, subhedral plagioclase (65 percent) with fine to very fine grained biotite (25 percent) and carbonate (7 percent). Sphene, chlorite, and opaque minerals are minor. The rock is distinctly different in composition from the other granitic rocks that were analysed (*see* Figures 3, 5, 10, and 11).

Pink and white varieties of aplite and pegmatite are fairly common in the Pukaskwa Gneissic Complex, although they are not numerous or voluminous. These rocks are uncommon in the Heron Bay Pluton except near the margins of the pluton, and are virtually absent from the Gowan Lake Pluton.

Middle to Late Precambrian

MAFIC INTRUSIVE ROCKS

Middle to Late Precambrian subalkalic diabase dikes of tholeiitic basalt composition (Table 8) intrude all the volcanic, sedimentary, and granitic units in the Hemlo area. These dikes vary from 1 to 60 m in thickness. Satellite dikes are smaller than this and may be as thin as several centimetres. The dikes generally weather a deep rusty brown, and on fresh surfaces, vary from dark grey-black in narrow, chilled dikes, to dark greenish black in phaneritic dikes. In some medium- to coarse-grained dikes, sericitized plagioclase imparts a somewhat lighter green colour to the rock. Magnetite crystals are commonly coarse enough to be recognized in hand specimen; the rocks will commonly attract a hand magnet.

Subhedral to euhedral, twinned (albite, Carlsbad), plagioclase laths that have been partly to heavily sericitized, form about 45 percent of the diabase. Subhedral to euhedral, twinned, pyroxene crystals constitute 45 percent to 50 percent of the rock. Uralite, biotite, quartz, and opaque minerals commonly account for up to 2 percent each. Minor carbonate may be present also. Some opaque minerals are anhedral and fill interstices, possibly reflecting late crystallization; others form subhedral to euhedral crystals which may indicate earlier crystallization took place early on. These mineral habits may occur in the same rock which may indicate that crystallization was controlled by availability of space instead. No olivine was found, but its apparent absence in the area should not be taken for granted since olivine diabase dikes were found in the Heron Bay area (Muir 1979).

TABLE 8 CHEMICAL ANALYSES OF SUBALKALIC DIABASE DIKES, HEMLO AREA.

SPECIMEN[ab] NUMBER	38	39
SiO_2	47.0	49.9
TiO_2	2.92	1.17
Al_2O_3	13.2	15.1
Fe_2O_3[c]	17.3	14.6
MnO	0.25	0.22
MgO	5.82	5.52
Ca	9.38	9.20
Na_2O	2.13	2.35
K_2O	0.83	1.25
P_2O_5	0.22	0.12
CO_2	0.16	0.20
S	0.14	0.11
TOTAL	99.4	99.7
L.O.I.[d]	1.2	1.1
S.G.[e]	3.10	3.05
N.P.C.[f]	55.7	56.1

SPECIMEN[ab] NUMBER	FIELD NUMBER	FIELD NAME	IRVINE AND BARAGAR	JENSEN (1976)
38	M-19-78	Diabase (Sub-alkaline).	Tholeiitic basalt.	High-iron tholeiitic basalt.
39	L85-78	Diabase (Sub-alkaline).	Tholeiitic basalt.	High-iron tholeiitic basalt.

Footnotes
a Corresponds to numbers used in Figures 3 to 6.
b Both samples contain modal quartz.
c Total iron as Fe_2O_3.
d Loss on ignition.
e Specific gravity.
f Normative plagioclase composition.

Notes
i) The suffix "-.78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Major components given as uncorrected weight percent.
iii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

Late Precambrian (Proterozoic)

ALKALIC INTRUSIVE ROCKS

The late alkalic dikes (Table 9) in the Hemlo area are significantly fewer than in the Heron Bay area. Only four dikes were located; three are lamprophyres. Two of the lamprophyres, located on Highway 17, 1.2 km east of Cigar Lake, are ultramafic in composition and are less than 0.4 m thick. Moderate fracturing results in an irregular, blocky pattern on weathered surfaces. Although the two dikes are different, they have some similarities. Both have pseudomorphed olivine phenocrysts presently consisting of chlorite (a different type in each dike) which are set in a very fine grained, altered matrix consisting of carbonate, talc, or muscovite, chlorite, and possibly pyroxene (Photo 10). Minor biotite is present as fine-grained, sub-porphyritic flakes. Opaque minerals are generally confined to the matrix as very fine grained, anhedral crystals.

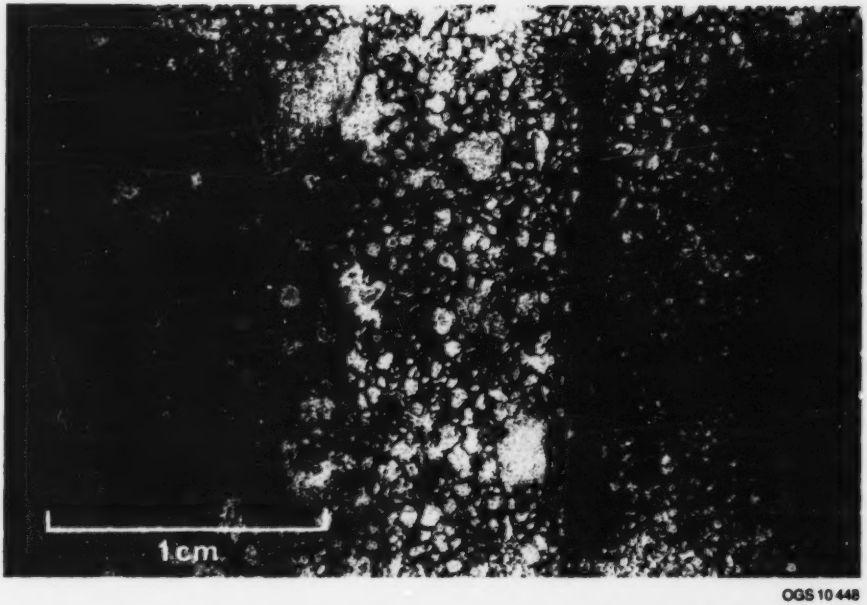

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Photo 10–Photomicrograph of completely altered ultramafic olivine lamprophyre showing numerous phenocrysts of many sizes and possibly some altered rock fragments. Highway 17, east of Hemlo turnoff.

TABLE 9 CHEMICAL ANALYSES OF ALKALIC DIKES, HEMLO AREA.

SPECIMEN[a] NUMBER	40	41	42
SiO_2	35.7	24.1	44.5
TiO_2	4.91	3.15	1.92
Al_2O_3	5.28	4.41	14.6
Fe_2O_3[b]	16.9	10.6	13.7
MnO	0.27	0.24	0.20
MgO	15.6	6.60	6.18
CaO	12.0	25.8	5.29
Na_2O	0.00	1.17	4.38
K_2O	1.10	1.65	1.16
P_2O_5	0.57	1.15	0.20
CO_2	2.36	19.2	5.92
S	0.18	0.52	0.43
TOTAL	94.9	98.6	98.5
L.O.I.[c]	7.8	19.3	8.6
S.G.[d]	2.96	2.92	2.83
N.P.C.[e]	99.2	15.4	29.9

SPECIMEN[a] NUMBER	FIELD NUMBER	FIELD NAME	IRVINE AND BARAGAR (1971a)
40.	M57-78	Ultramafic lamprophyre.	Ultramafic.
41	M77B-78	(Biotite) gabbroic lamprophyre.	Mugearite; sodic alkali-basalt series.
42	L71-78	Syenitic dike.	Hawaiite, sodic alkali-basalt series.

Footnotes

a Corresponds to numbers used in Figures 3 to 6.
b Total iron as Fe_2O_3.
c Loss on ignition.
d Specific gravity.
e Normative plagioclase composition.

Notes

i) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452 (back pocket).
ii) Major components given as uncorrected weight percent.
iii) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

A bifurcating, rusty-weathering biotite lamprophyre of unusual composition is located on Highway 17 south of Moose Lake. The matrix of the dike is aphanitic and grey, and contains about 4 percent subhedral brown biotite phenocrysts as flakes up to 2 mm long. Several small, equant, euhedral, nepheline phenocrysts, less than 0.5 mm long, are also present in the matrix. The matrix appears to consist of pyroxene, carbonate, and muscovite. Opaque minerals are present as very fine grained, anhedral to subhedral crystals (up to 6 percent).

A poorly-exposed, aphanitic, greyish brown, basaltic dike is located south of Rous Lake. It consists of about 45 percent very fine grained plagioclase (less than 0.3 mm), 15 percent chlorite, and 5 percent opaque minerals in an altered, finer grained matrix.

Cenozoic

QUATERNARY

Pleistocene and Recent

Only a few outcrops have retained glacial striae on their surfaces; most of these are found on lakeshores and locally along Highway 17. The general trend indicated by the striae is slightly west of southwest; this has been partly confirmed in the field by another method. A 3.5 m diameter erratic of peridotite was found just east of the lake that lies on the Pukaskwa Gneissic Complex/Playter Harbour Sequence contact at the west border of the map-area. A line projected back from this location in the direction of a striae measurement (053°) taken on the large island in Mussy Lake (about 6.2 km away) passes within 45 m of five outcrops of similar peridotite over a distance of from 0.8 km to 1.5 km from the erratic.

Glaciolacustrine deposits up to 30 m thick are located in an east-northeast to north-northeast-trending zone north of Rous Lake and are presently incised by the Black River (an underfit stream) which meanders through the valley. The deposits consist mainly of fine sand, silt, and varved clay which are locally intimately mixed. The Rous Lake Borrow Pit[1] located about 1 km northwest of Rous Lake, was originally an old pit about 277 m by 181 m by 5 m deep in 1962 that supplied sand for highway construction in the 1950s. Subsequently, the pit eroded through to the Black River and undercut its own walls by water derived from a relatively rapid groundwater flow system. The pit has grown significantly in dimensions which, in 1976, exceeded 393 m by 351 m by 29 m deep. The estimated erosion of material is about 1.5 million tons from about 1962-1976. The pit offers an excellent opportunity to view examples of water erosion,

[1]Most information on the pit and the geology is taken from 'Rous Lake Borrow Pit', unpublished report by K.G. Fenwick, Regional Mineral Resources Coordinator, Ministry of Natural Resources, Thunder Bay.

mass movement, and slumping as well as a cross-section of the glaciolacustrine deposits.

Several relatively large flat areas of sand and swamp are present in the area; these are located west of Rous Lake, west of Campfire Lake, west of Mussy Lake, and south of Hayward Lake. The largest flat sandy area lies west of Mussy Lake from the White River, northwest into the Hemlo area, and is incised by numerous streams. The deposits consist mainly of fine sand and silt with minor amounts of clay and are probably related to the deposits that lie in the Black River valley. Several stationary sand dunes lie about 1.6 km west of the south end of Mussy Lake.

Metamorphism

A detailed study of metamorphism was not done. Most rocks, however, do not indicate metamorphic grades because of their mineralogy. A few units have provided enough information to enable an approximate estimate of maximum grade of metamorphism to be made. Regional metamorphism is probably low grade, low temperature (Muir 1979) as defined by Winkler (1976). The thickness of supracrustal rocks between granitic bodies as seen on Map 2452, back pocket, however, is narrow enough in most areas such that most of the rocks are at least of low grade, high temperature metamorphism; and many of the rocks within about 1.5 km of the granitic rocks are medium grade. Medium-grained, amphibolitized mafic metavolcanics are common. Some pelitic rocks have been metamorphosed to schists containing metamorphic minerals indicative of metamorphic rank. Samples from an outcrop at the bend in Highway 17 near the east boundary of the map-area show garnet, staurolite, anthophyllite, and muscovite in different beds (*see* Photos 4, 5). This indicates medium grade metamorphism (Winkler 1976), but more specific data cannot be obtained from this information. Staurolite (retrograded to sericite) was found with garnet and biotite in a dark schist about 3.3 km west-southwest of Gowan Lake. A pelitic schist from an outcrop about 4 km southwest of Gowan Lake contains sillimanite, andalusite, cordierite, biotite, and garnet (*see* Photo 6). The cordierite has retrograded to pinite. This could put very approximate conditions of maximum metamorphism around 3.0 kb to 3.4 kb and 510°C to 530°C (D.M. Carmichael; unpublished petrogenetic grid diagram, 1979).

Petrochemistry

Partial chemical analyses were made of representative handspecimens of all the major rock types. Precise locations of the samples are indicated on Map 2452 (back pocket). Because of the limited number of analyses that were made, the discussion on petrochemistry is restricted to generalizations. Plots derived by T.N. Irvine and W.R.A. Baragar (1971) and L.S. Jensen (1976) are used to compare the rocks, since agreement on classifications is not universally accepted. In addition, the inclusion of intrusive rocks on extrusive rock classification diagrams is meant merely for comparative purposes. Comparisons between the

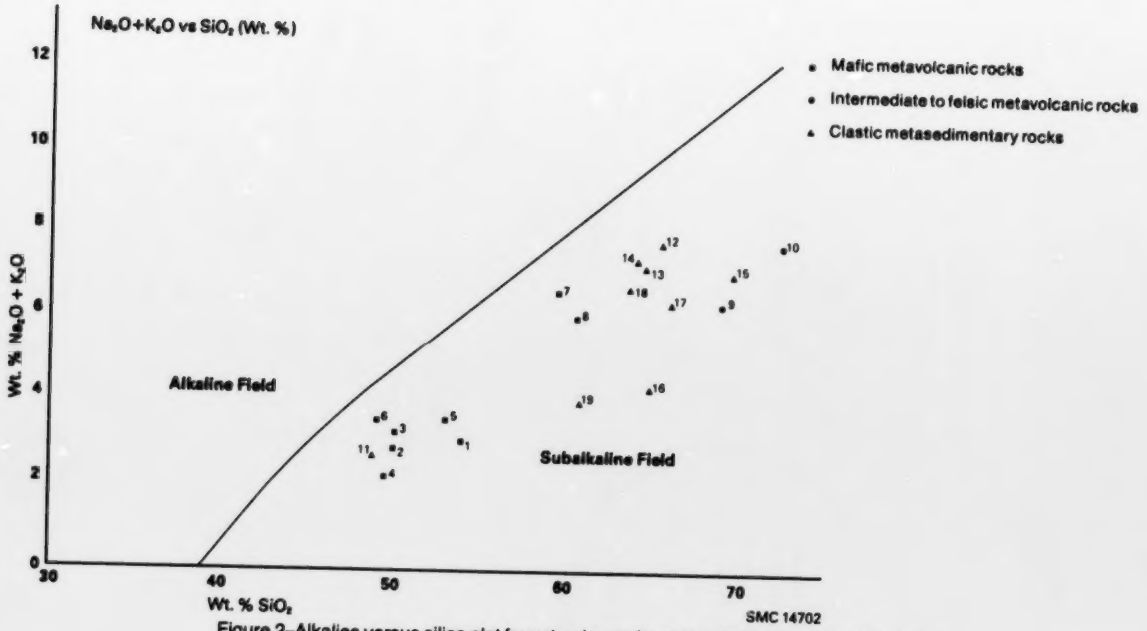

Figure 2–Alkalies versus silica plot for extrusive rocks and sedimentary rocks, Hemlo Area.

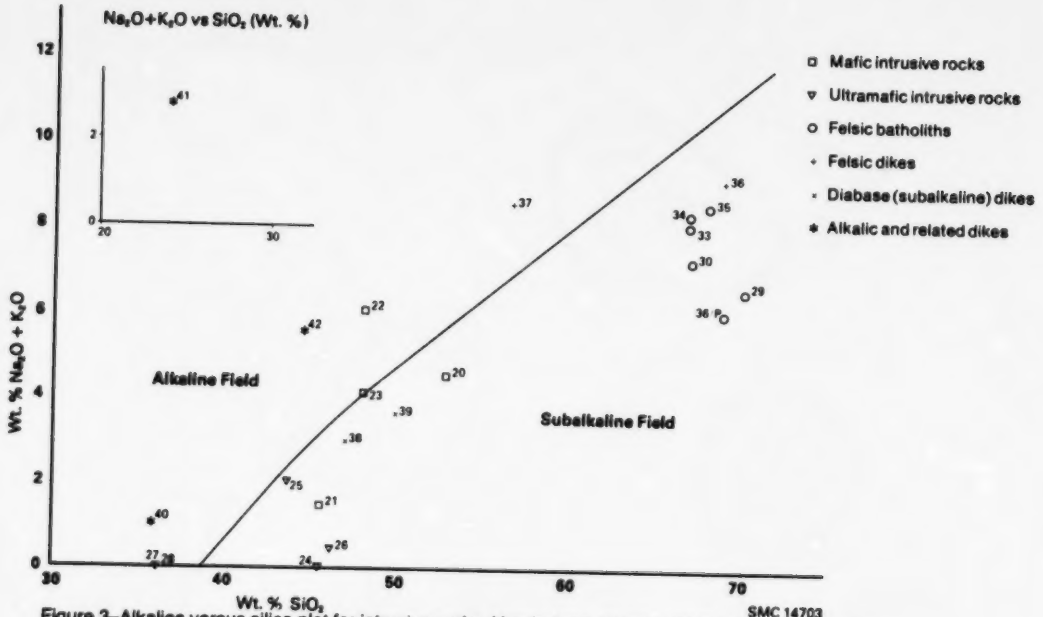

Figure 3–Alkalies versus silica plot for intrusive rocks, Hemlo Area. Number 36/P represents Specimen 36 (Pukaskwa Gneissic Complex), see Muir 1979.

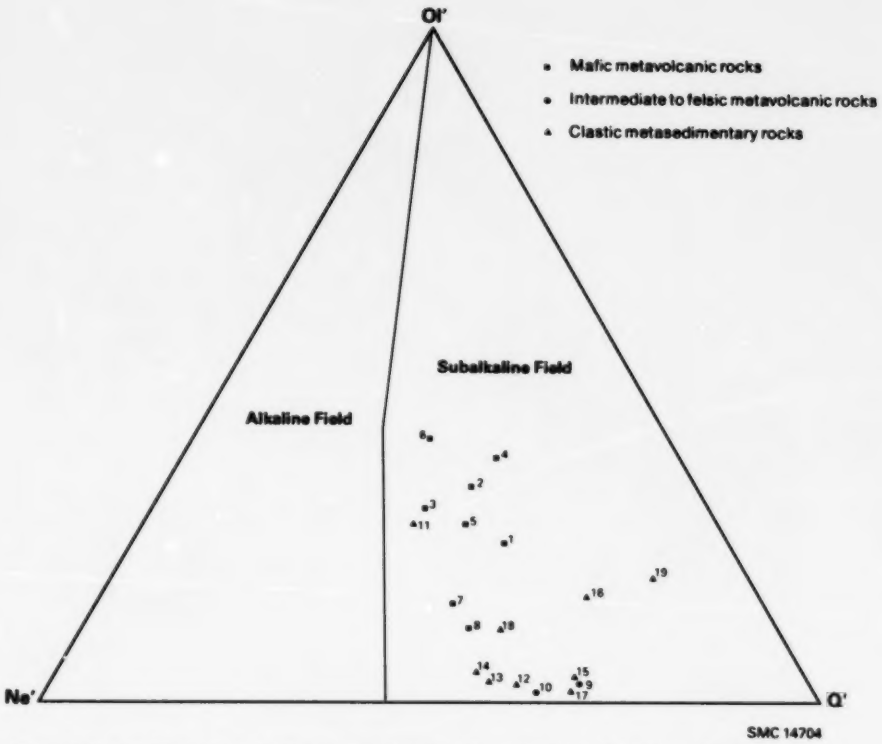

Figure 4–Ne'-Ol'-Q' plot for extrusive rocks and metasediments, Hemlo Area. Legend as for Figure 2.

Heron Bay area (Muir 1979) and the Hemlo area are mentioned where applicable. It is hoped that some useful information can be obtained from the results, and that they may prompt further field studies by other workers at a future date.

The distinction between reworked and non-reworked sedimentary rocks (tuffaceous) was based on empirical criteria (*see* section on "Metasediments") that are unproven generalizations; this has led to some arbitrary classifications. Thus, undefined or unexpected problems in petrochemical interpretations of this rock type may arise.

The metavolcanics and metasediments are all subalkalic (Figures 2, 3, 4, and 5). Most of the mafic volcanic rocks are high-iron tholeiitic basalts. The mafic pyroclastic rocks are high-alumina calc-alkalic andesites; this reflects the more explosive type of volcanism associated with calc-alkalic rocks. Intermediate to felsic metavolcanics and rocks classified as non-reworked and reworked metasediments (*see* Table 4) generally plot within the intermediate to felsic metavolcanic trend. Compared to the Heron Bay area (Muir 1979), there is a specific lack of rocks of dacitic composition (Figures 6, 7, 8, and 9). The rea-

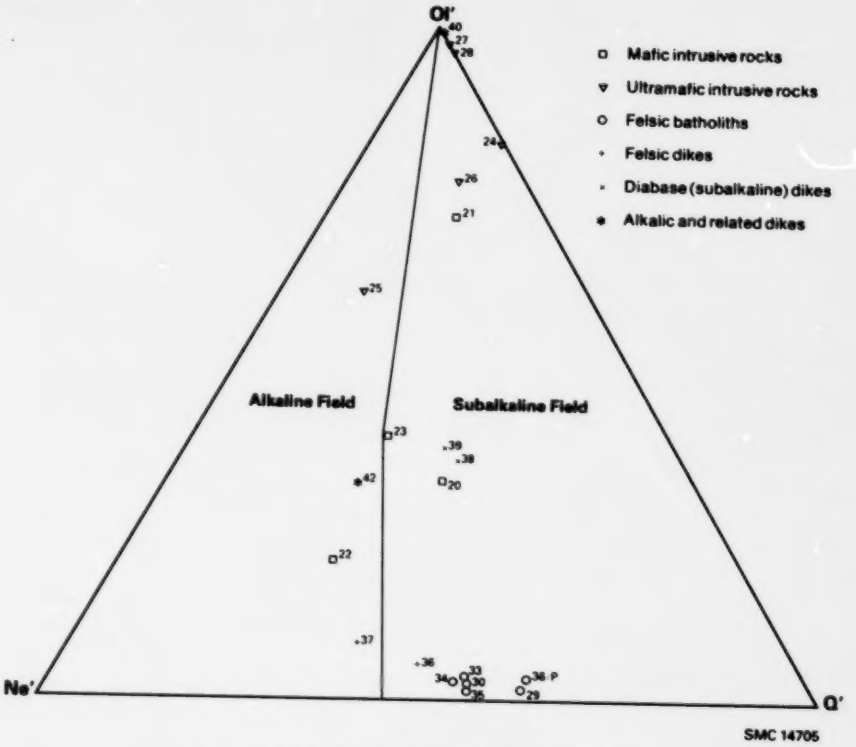

Figure 5–Ne'-Ol'-Q' plot for intrusive rocks, Hemlo Area.

sons for this are probably two fold;

1) Incomplete sample coverage with respect to the volcanic rocks;

2) A lack of an actual complete volcanic suite due to the mixed presence of water-deposited, reworked, and non-reworked tuffs as sediments.

The intrusive rocks do not show any important differences from those in the Heron Bay area. According to the Ne'-Ol'-Q' diagram (Figure 5), both the pyroxenite (sample number 25) and the related gabbro (sample number 22) are alkalic. The alkalies-silica plot (Figure 3) does not indicate this. In the Heron Bay area, samples of amphibolitized pyroxenite, adjacent gabbro, and overlying very dark green mafic metavolcanics were all classified as alkalic on a Ne'-Ol'-Q' plot (Muir 1979). The sample of related gabbro (sample number 22)

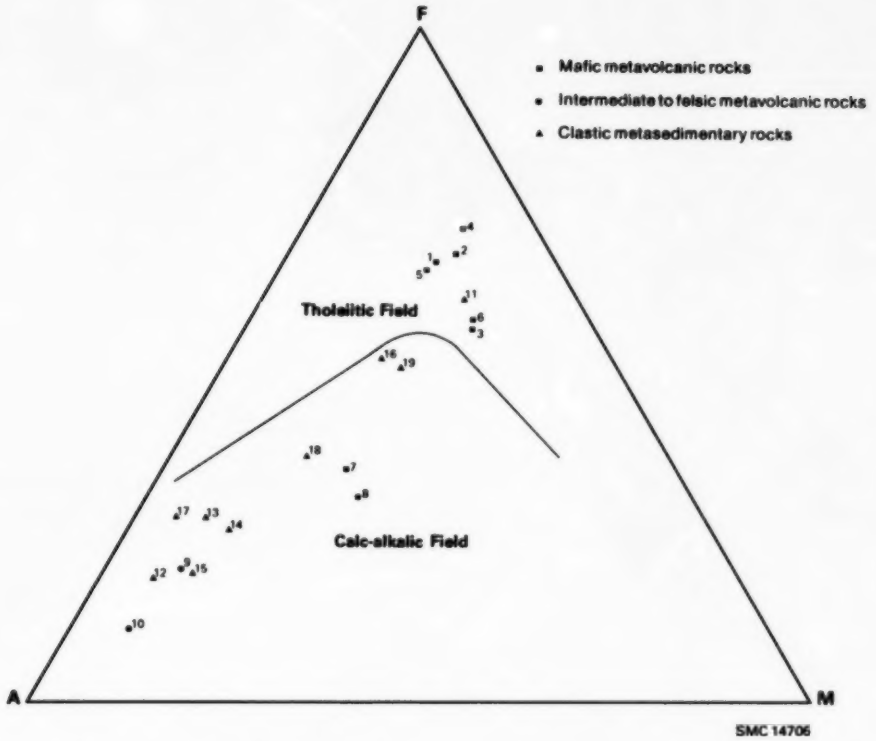

Figure 6–AFM triangular plot for extrusive rocks and sedimentary rocks, Hemlo Area. After Irvine and Baragar (1971).

is less rich in magnesium than the other intrusive and extrusive mafic rocks. A sample of alkalic biotite lamprophyre (sample number 41) is significantly low in silica and relatively high in alkalies (Figure 3).

The relative positions of the granitic rock units are shown in Figures 10 and 11 as normative components (weight percent) on classification diagrams by L.D. Ayres (1972, 1974). The greatest differences between the granitic bodies lie in the different plagioclase to potassium feldspar ratios. Figure 10 shows that the An composition of the plagioclase of the units is similar.

The trace elements Ba, Co, Cr, Cu, Li, Ni, Pb, and Zn were analyzed (Table 10). Statistically, too few samples were analyzed to make conclusive statements, but a few generalizations may be made.

The calc-alkalic andesites, compared to the tholeiitic basalts (*see* Tables 2 and 10), are distinctly higher in Ba, and lower in Co and Zn. The calc-alkalic dacites and rhyolites, compared to the andesites are lower in Cu, Ni, and Zn. A general increase in Co, Cu, and Zn occurs from intermediate to felsic pyroclastic rocks, to sedimentary rocks derived from unlithified intermediate to felsic

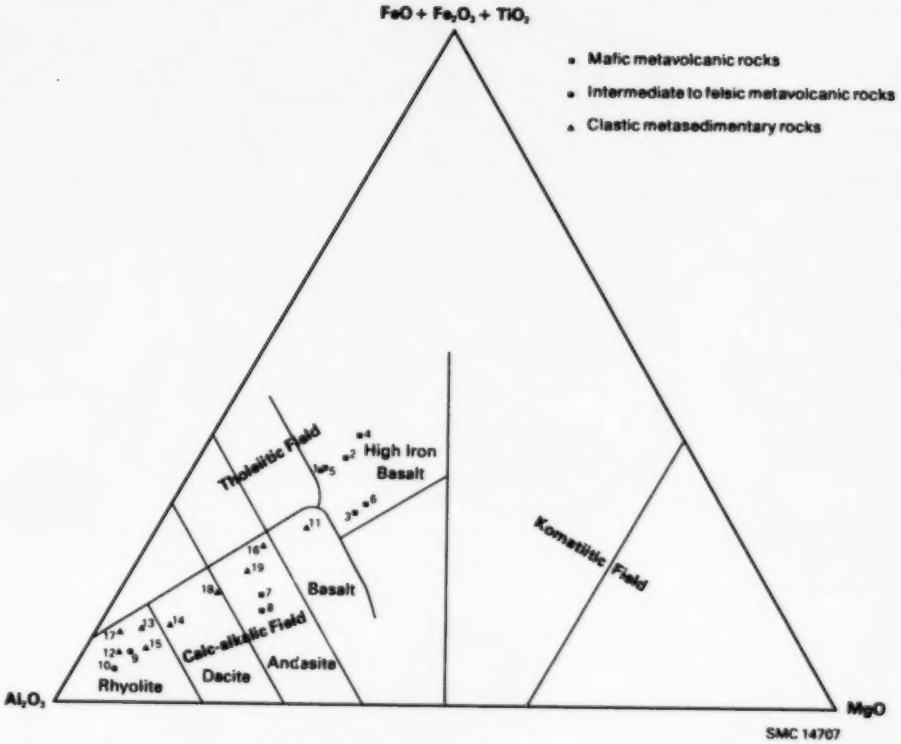

Figure 7–Al_2O_3 - Fe_2O_3 + FeO + TiO_2-MgO diagram for extrusive and sedimentary rocks, Hemlo Area. After Jensen (1976).
Legend is same as for Figure 2.

volcanic material, to sedimentary rocks of intermediate composition derived from detritus (reworked). The reworked sedimentary rocks are slightly higher in Cr and Li, and higher in Ni and Pb than are the intermediate to felsic pyroclastic rocks.

The Heron Bay Pluton is very similar to the Cedar Lake Pluton in the abundance of the above-selected trace elements except that it is somewhat higher in Cr. The Heron Bay Pluton, compared to the Gowan Lake Pluton is lower in Cr, Cu, and Ni, and higher in Li. The Heron Bay Pluton compared to the Pukaskwa Gneissic Complex is higher in Ba, Li, Pb, and Zn. The Gowan Lake Pluton compared to the Pukaskwa Gneissic Complex is higher in Ba, Cr, Cu (slightly), Ni, Pb, and Zn. The Heron Bay, Cedar Lake, and Gowan Lake Plutons in general are somewhat higher in Ba, Li, Pb, and Zn compared to the Pukaskwa Gneissic Complex.

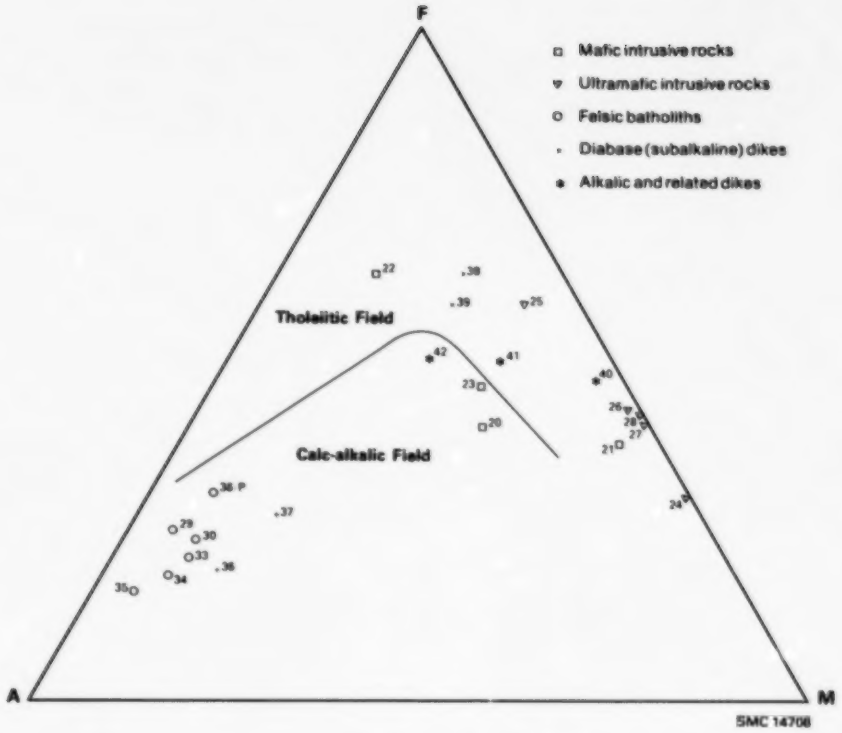

Figure 8–AFM diagram, for intrusive rocks, Hemlo Area. After Irvine and Baragar (1971).

STRUCTURAL GEOLOGY

Few primary features were observed which could be used to interprete the structural geology of the map-area. Pillows are too deformed for top determinations to be made. Bedding is commonly well-preserved in those metasediments that were derived from volcanic rocks. The reworked metasediments are weakly bedded to massive. Most of the rocks, however, were fine- to very fine-grained deposits, and recrystallization has virtually obliterated any primary structures indicative of stratigraphic tops.

Folding and Stratigraphy

The supracrustal rocks of the Hemlo area are divided into two sequences:

1) The Playter Harbour Sequence, which is bounded by the Pukaskwa Gneissic Complex and the Heron Bay Pluton,

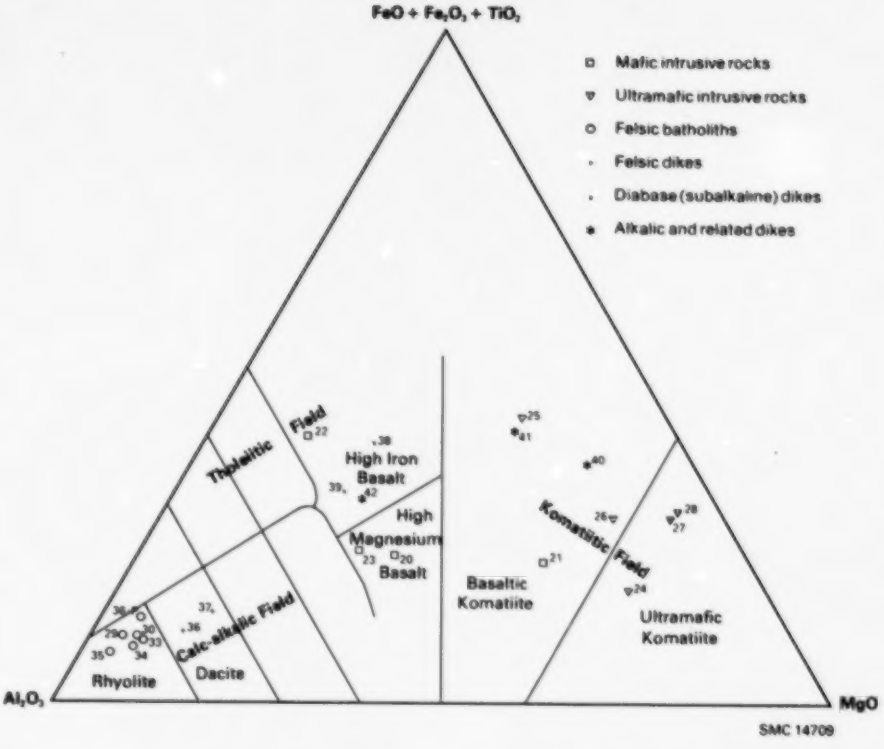

Figure 9–Another Al_2O_3 - Fe_2O_3 + FeO + TiO_2-MgO diagram, Hemlo Area for intrusive rocks. After Jensen (1976).

2) The Heron Bay Sequence, which is bounded by the Heron Bay Pluton and the Gowan Lake Pluton in the west, bifurcates in the east and is bounded by the Pukaskwa Gneissic Complex, the Cedar Lake Pluton, and the Gowan Lake Pluton.

Where observed, bedding generally dips moderately to steeply to the north, but local, steep, southerly dipping beds are present. This does not necessarily imply folding. The beds are envisaged to represent sub-vertical layers that in cross-section are deformed from the vertical position in both directions. The lack of definitive structural or stratigraphic data prevents identification of the Heron Bay Sequence as a monoclinal structure or a tight isoclinal fold. For the most part, strikes are conformable to the pluton contacts, but disconformable relationships are locally present. It is not uncommon to have beds in the contact margins dipping steeply towards the granitic intrusions.

A relatively small, tight, overturned syncline is exposed over a distance of about 20 m adjacent to Highway 17 near the eastern border of the map-area. Here, foliation is approximately perpendicular to poorly defined bedding at the

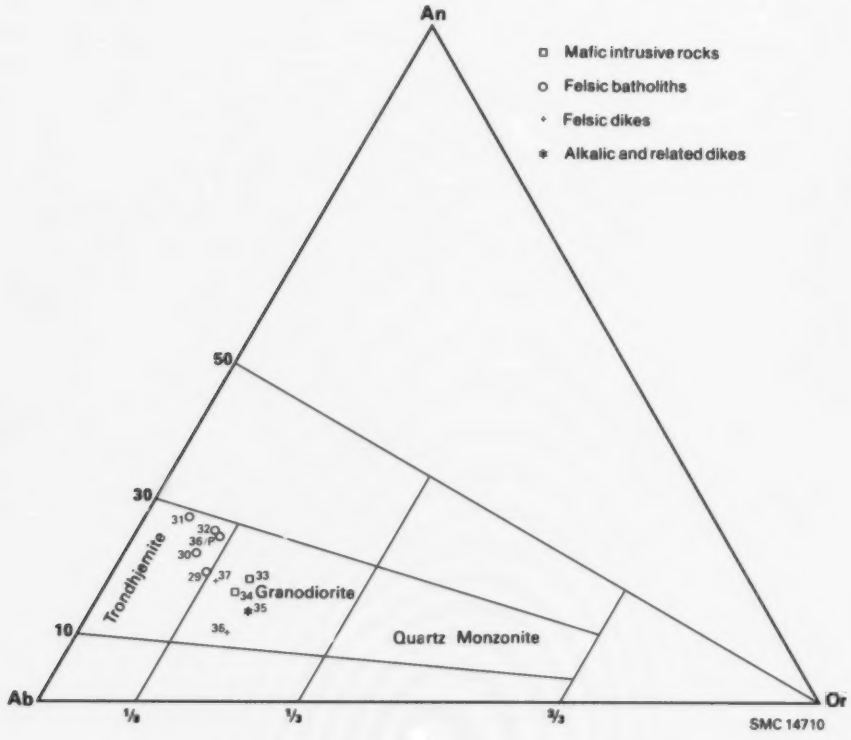

Figure 10–Ab-An-Or diagram, after Ayres (1972), showing classification of granitic rocks.

crest of the fold. The fold could not be related to larger structures. The fold is shown on the Preliminary Map P.2304 (Muir and Lafleur 1979) but was omitted from Map 2452 (back pocket).

One unusual rock type found at several locations throughout the area (*see* section "Mafic Metavolcanics") produces some interesting implications for the structure of the Playter Harbour Sequence and possibly for the relationship between the Playter Harbour and Heron Bay Sequences. These rocks, also found in the Heron Bay area, are commonly strongly amphibolitized, recrystallized, and locally deformed in the Hemlo area (Photo 11). Figure 12 shows the location of the outcrops of this unusual mafic metavolcanic containing felsic fragments (possibly feldspar phenocrysts) that have been interpreted by the writer to be related genetically to each other (time stratigraphic?). The distribution of these rocks as well as some structural data suggests;

1) A large scale, west-plunging synform/antiform pair is present west of Mussy Lake,

2) The mafic metavolcanics in contact with the Pukaskwa Gneissic

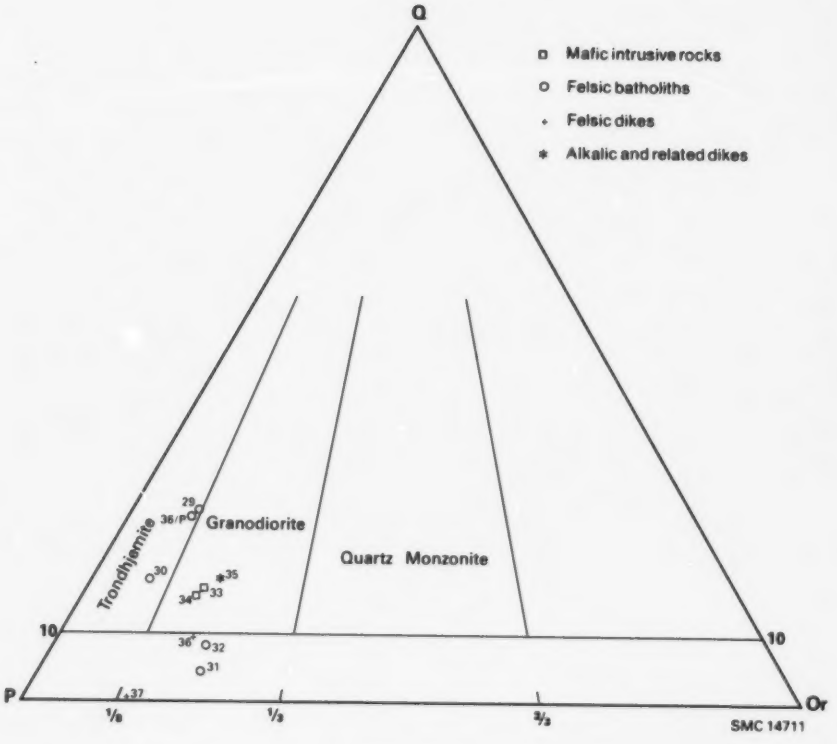

Figure 11–P-Q-Or diagram, after Ayres (1974), showing classification of granitic rocks.

Complex both in the Playter Harbour Sequence and in the Heron Bay Sequence at one time formed a continuous stratigraphic sequence which has been partly destroyed by the intrusion of the Heron Bay Pluton and the Pukaskwa Gneissic Complex.

Figure 13a shows a hypothetical cross-section through the synform, and Figure 13b shows a hypothetical cross-section through the two granitic bodies. It is apparent from the geological map that the mafic metavolcanics have been pinched out and(or) eroded away along the join between the two granitic bodies.

If the Pukaskwa Gneissic Complex represents the sialic basement on which the supracrustal rocks were deposited (conjecture), and if the Heron Bay Pluton represents melted and remobilized sialic material, then;

1) The non-distinct boundary between the two granitic bodies (*see* section on "Heron Bay Pluton") may be explained.

2) A relationship between the two types of granitic "intrusions" is worthy of further study to test such an hypothesis.

TABLE 10 TRACE ELEMENT RESULTS TO SUPPLEMENT THE PARTIAL ANALYSES, HEMLO AREA.

ROCK TYPE		SAMPLE NUMBER	Ba	Co	Cr	Cu	Li	Ni	Pb	Zn
Mafic Metavolcanics	Tholeiitic	M36-78	140	42	25	25	10	30	<10	130
		M41-78	130	48	84	59	18	52	<10	126
		M48-78	80	46	490	46	16	100	<10	102
		M112-78	40	47	13	92	14	19	<10	110
		M140A-78	40	39	17	88	12	28	293	240
		L51-78	130	46	250	38	16	98	10	162
	Calc-Alkalic	M136-78	700	21	208	42	15	62	18	84
		L87-78	690	21	280	36	16	87	14	65
Intermediate to Felsic Metavolcanics		M163-78	490	8	22	12	35	10	<10	42
		L91-78	540	<5	10	10	11	8	<10	44
Metasediments	Unlithified Volcanic Material	M25-78	130	33	84	12	9	32	<10	94
		M45-78	860	9	17	6	18	8	12	44
		M58-78	590	11	36	27	18	19	16	58
		M120-78	770	15	54	58	16	23	16	96
		M146-78	940	9	14	22	14	11	16	92
	Detritus (reworked)	M21-78	270	25	125	98	41	41	12	75
		M91-78	340	28	46	260	6	100	16	1120
		M94-78	640	16	87	33	34	18	15	86
		L89-78	430	45	470	62	36	220	<10	129

Notes

i) Chemical analyses by Geoscience Laboratories, Ontario Geological Survey.

ii) The suffix "-78" has been deleted from the sample numbers plotted on Map 2452, back pocket.

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Photo 11–Tight folding of amphibolitized mafic pyroclastic rock similar (related to ?) mafic pyroclastic unit traceable across Heron Bay and Hemlo Areas. Island in Mussy Lake.

Lineaments and Faults

Numerous lineaments occur throughout the map-area, and are particularly well displayed within the Pukaskwa Gneissic Complex. Many may represent faults, but such an interpretation was not used unless further field evidence indicated this. A few subparallel to parallel lineaments are present both in the Playter Harbour Sequence as a continuation of those from Lake Superior and in the Heron Bay Sequence. Some of the latter have previously been interpreted to be faults by prospectors and exploration geologists (Assessment File reports); but a detailed study of such interpretations was not undertaken in the field. It is quite possible that Highway 17 closely follows and partly masks a major fault which is locally seen as a shear zone in some outcrops adjacent to the highway.

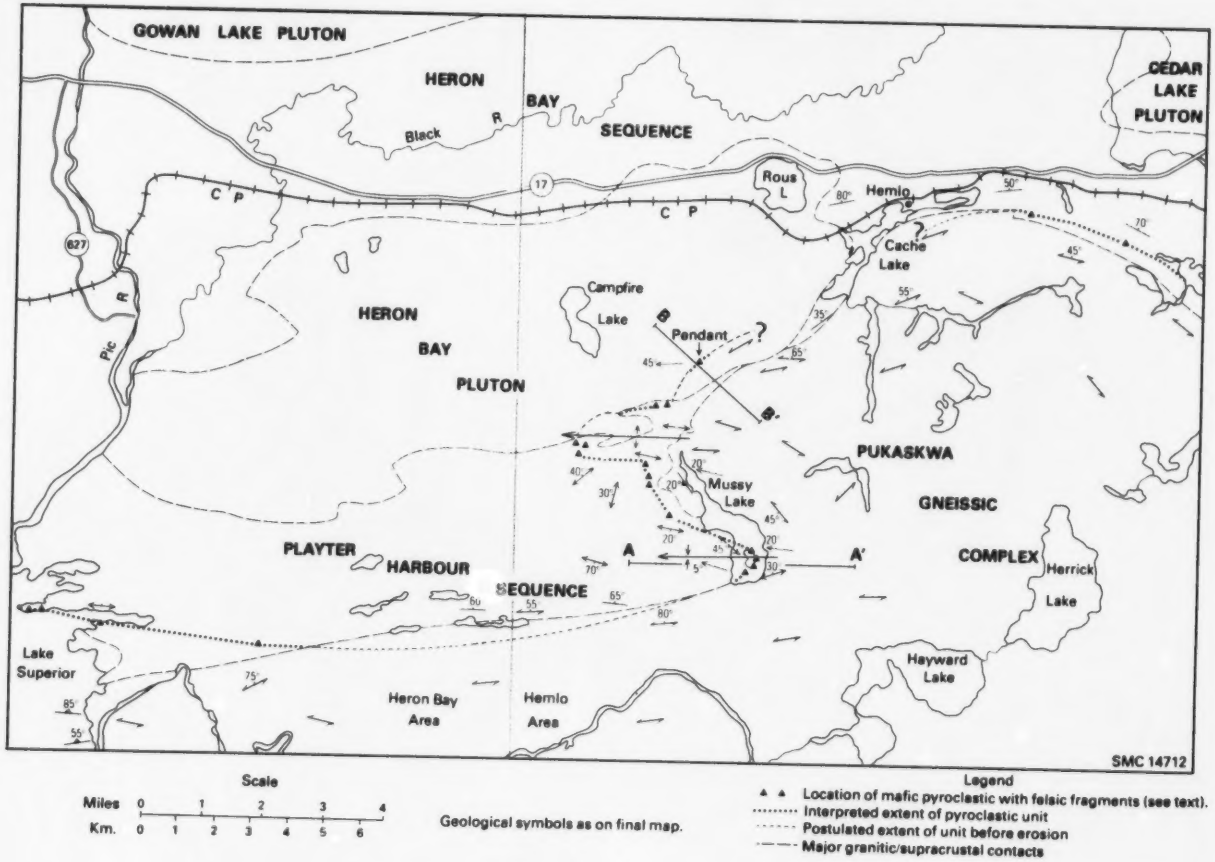

Figure 12–Proposed structure around Mussy Lake and possible correlations of one unit. Shows positions of sketched sections for Figure 13.

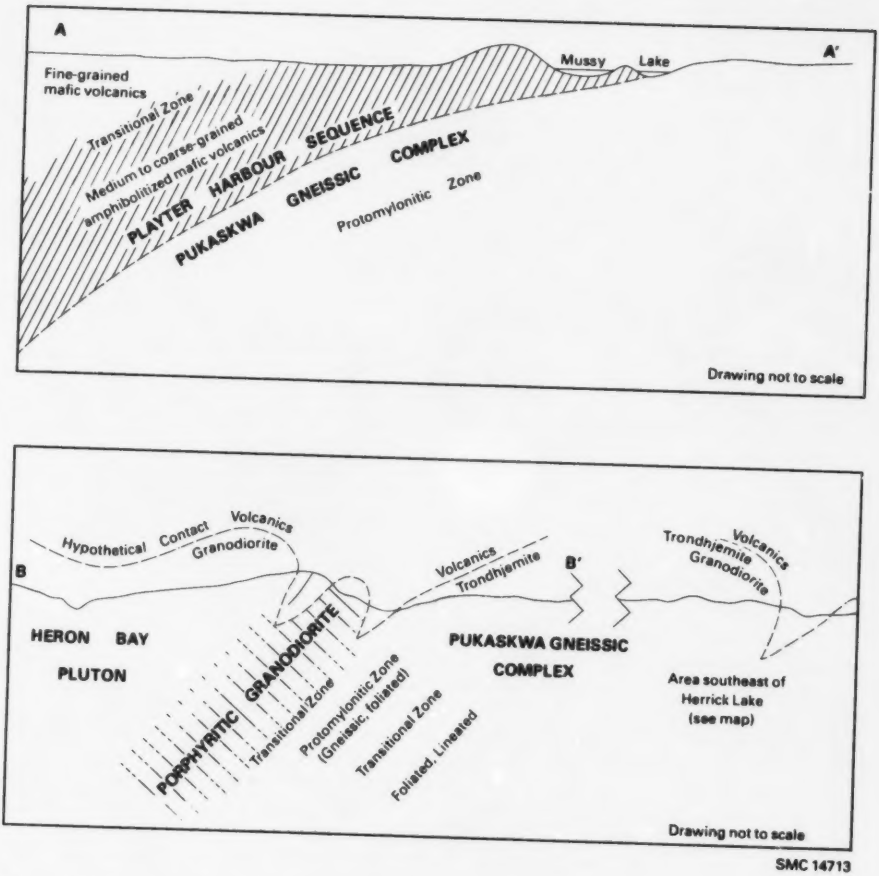

Figure 13–Hypothetical cross-sectional sketches to explain the relationship between the Playter Harbour Sequence and the Pukaskwa Gneissic Complex.

ECONOMIC GEOLOGY[1]

Minor mineral exploration work was carried out to the west of the Hemlo area in the Heron Bay area as early as the 1870s (Bell 1873; Thompson 1931). The first work in the map-area was referred to in a report by Bartley and Page (1957) in which they briefly mention work carried out on a gold prospect near Hemlo in the early 1920s by J. Lecour. The first work done in the area which was recorded in the Assessment Research Files was done in 1945 by Messrs. Ollmann and Williams on a section of ground west of Cedar Creek and Highway 17 that is currently held by Mrs. L.G. Williams (the Ollmann-Williams prospect) (8)[2]. The exploration work was carried out for gold, and a number of claims surrounding the original claim group have been periodically staked by different interests (Lake Superior Mining Corporation Limited, Ardel Explorations Limited, and R.G. Newman) up to the time of writing (October 25, 1979).[3]

Other recorded work carried out in the Hemlo area includes the delineation of conductors by the Noranda Exploration Company Limited (5) to the northeast of Rous Lake on one claim group, and by Noranda Mines Limited (6) northwest and west of Rous Lake on two claim groups.

In 1965, Keevil Mining Group Limited conducted an airborne magnetic and electromagnetic survey over a large part of the Heron Bay area and a small part of the Hemlo Area, but their claim group lay completely outside the Hemlo Area.

It is known that other early work was carried out in the Hemlo area by various prospectors (Bartley and Page 1957), but none of this is recorded in the Assessment Files. Only two small test pits were found during the 1978 field-mapping season; one is south of Hemlo near the northern shore of the east end of Cache Lake, and the other is located about 0.4 km north of Highway 17 from a point about 2 km east of the Hemlo turnoff. The first pit occurs in schistose, intermediate to felsic tuffs, and has a number of irregularly-shaped, discontinuous, quartz stringers and veins. Only trace amounts of gold and silver were obtained from a grab sample taken by the writer (analysed by the Geoscience Laboratories, Ontario Geological Survey). The second pit occurs in intermediate to mafic tuff; visible mineralization consists of minor concentrations of py-

[1]All the information in this section that pertains to mineral exploration has been obtained from the Assessment Research Files in the office of the Resident Geologist at Thunder Bay, Ontario, unless otherwise noted.

[2]The number in parentheses indicates the property number on Map 2452, back pocket.

[3]During 1981 and 1982, Corona Resources Limited and Teck Corporation undertook a significant diamond drilling program and outlined a relatively large, low-grade gold deposit centred on the ground described as the Lake Superior Prospect (3) in this report. Grade, dimension, and tonnage figures can be found in McIlwaine *et al.* (1982, p.51,52), and in articles in the Northern Miner: August 13, 1981, p.3; August 20, 1981, p.A7; and February 25, 1982, p.3. Parts of the surrounding area are currently held by a number of companies, none of which is described in this report.

rite. A grab sample taken by the author also returned trace precious metal values and very low base-metal values (Geoscience Laboratories, Ontario Geological Survey).

Grab samples were taken during the field season from several gossans, mainly in roadside outcrops on Highway 17. All samples returned "nil" or "trace" gold and silver values, except for one specimen (*see* section on "Gold and Silver"), and also gave very low values for Cu, Mo, Ni, Pb, and Zn (Geoscience Laboratories, Ontario Geological Survey). Minor occurrences of pyrite, pyrrhotite, sphalerite, chalcopyrite, tourmaline, gold, and silver were reported near Highway 17 between Hemlo and Cedar Creek (Bartley and Page 1957). A trace of molybdenite was observed by the author in a hand specimen taken about 0.8 km west-northwest of the north end of Mussy Lake; the identification made of the host rock was uncertain, but it appeared to be an amphibolitized mafic rock.

Reference was made previously to the "Hemlo Occurrence" (Lang 1952) on a gold property held in 1949 by Lake Superior Mining Corporation Limited, but assessment file material indicates that the occurrence was on unstaked ground south of the above-mentioned property about 1.6 km south-southwest of Moose Lake. Mildly anomalous total radioactivity values from five parallel radioactive zones were mentioned, but no work was filed for credit.

Quaternary clay, silt, sand, and minor gravel deposits locally form significant deposits in the Hemlo area, but to date these deposits have rarely been used for construction materials. A minor exception is a small sand pit about 1.2 km northwest of Rous Lake. The pit subsequently had an erosional route opened up to the Black River, and due to ground water flowage has been transformed into a large, deep pit within sand, silt, and clay. The pit has become a local curiosity and is an excellent example of hydrogeologically-induced mass erosion.

Gold and Silver

Most of the exploration work carried out in the Hemlo area has specifically been for gold and silver. Other work has been of a general nature, such as the examination of geophysically detected electromagnetic conductors. Virtually all of the recorded gold exploration work has been centred around the Lake Superior Prospect (3). On this and adjoining properties, low-grade gold values were found to be associated with various types of pyritiferous feldspar porphyry and quartz-feldspar porphyry dikes within metasediments and tuffaceous rocks. Visible gold was reported from one diamond-drill hole. A grab sample of pyritiferous felsic tuff in close proximity to feldspar porphyry, taken by the author, just off the north side of Highway 17 near the junction with a gravel road about 2 km east of the turnoff to Hemlo, returned values of 0.32 ounce of Au per ton and 0.48 ounce of Ag per ton (Geoscience Laboratories, Ontario Geological Survey).

Properties and Deposits

The following is a description of the properties, deposits, and unclaimed parcels of land for which assessment work was available as of September 30, 1978. The reader should refer to Figure 14 for locations of past and present property locations and to Table 11 for a summary of the work that has been done. The numbers in parentheses after each property name indicates the property number on Map 2452, back pocket.

ARDEL EXPLORATIONS LIMITED [1973] (1)

In 1973, Ardel Explorations Limited staked 12 claims which covered part of the larger claim group held by Lake Superior Mining Corporation Limited in the 1940s and 1950s. The claims straddled Highway 17 between Cedar Creek and Moose Lake. The geology is described in the section "Lake Superior Prospect (3)".

Diamond drilling on the claims was undertaken to improve the definition of the "Lake Superior Fault Zone" (*see* section on "Lake Superior Prospect (3)") and to test for gold mineralization. Finely bedded to massive, grayish wacke and minor porphyry was intersected in three holes drilled for a total length of 229 m over a strike length of about 60 m. The three holes returned values of 0.15 ounce of gold per ton across 1.1 m, 0.17 ounce of gold per ton across 1.2 m, and 0.21 ounce of gold per ton across 3.5 m respectively.

Assessment file reports show that the results of the drilling by Lake Superior Mining Corporation Limited and Ardel Explorations Limited gave an average of 7.20 ppm Au across a length of 2.2 m for a strike length of 370 m for 12 shallow diamond-drill holes, and 7.54 ppm Au across 1.7 m over a strike length of 120 m for seven deeper holes. This would outline a mineralized body of about 150 000 tons at 7.20 ppm Au above 18 m depth (The Northern Miner, February 14, 1974, p.9).

Although further drilling was recommended, this was not followed up, and the claims were allowed to lapse.

KEEVIL MINING GROUP LIMITED (BARRET OPTION) [1965] (2)

In April 1965, Keevil Mining Group Limited undertook a combined electromagnetic and magnetometer airborne survey over an area in order to cover their group of 29 contiguous claims, all of which lay in the Heron Bay area to the west. However, the area flown overlapped into the Hemlo area by about 2 km in the west-southwest section of the map-area. The survey was flown using north-south and east-west flight lines. No electromagnetic anomalies were detected. The area is underlain by tholeiitic mafic flows and minor intercalated intermediate to felsic tuffs that have been cut by lenses of pyroxenite, lherzolite, and gabbro. The ultramafic and mafic rocks produce a relatively strong east-west magnetic anomaly. No further work was undertaken by the company in the Hemlo Area.

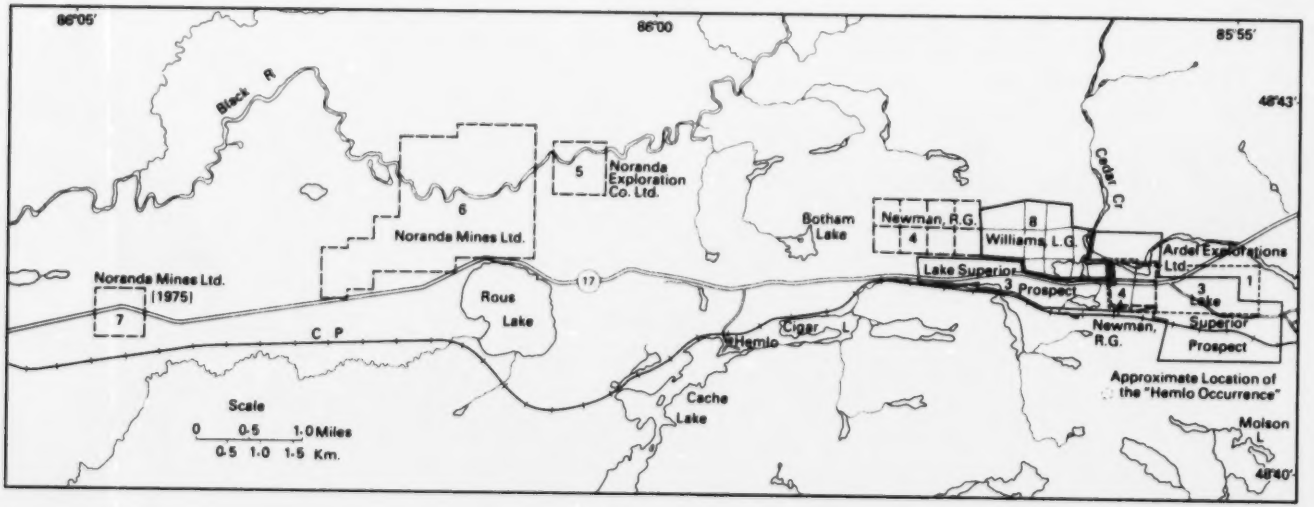

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Figure 14–Past and current property locations for the Hemlo Area; see text for property descriptions.

TABLE 11 LIST OF PROPERTIES AND DEPOSITS, HEMLO AREA.

Number on Map:	Name	Year	Recorded No. of Claims	Geological Map	Magnetometer	Electro Magnetic	Soil Geochemical	Number of drill holes	Total Length (m)	Remarks
1	Ardel Explorations Limited (1978)	1973	12	—	—	—	—	3	229	Lapsed: to extend work of Prospect No. 3.
2	Keevil Mining Group Limited (Barrett Option) (1965)	1965		—	A*	A*	—	—	—	Lapsed; claims in Heron Bay but coverage extended into Hemlo Area.
3	Lake Superior Prospect	1946 to 1959	33	X	—	—	—	21	1665	Lapsed; More holes were actually drilled.
4	Newman, R.G.	1977, 1978(?)	8,4	X	—	X	X	—	—	Two claim groups; soil survey for Au, Ag, Cu, Pb, Zn, on group one.
5	Noranda Exploration Company Limited	1975(?)	4	—	X	X	—	—	—	
6	Noranda Mines Limited	1974(?) 1975	31	—	X	X	—	4	547	
7	Noranda Mines Limited (1975)	1974(?)	4	—	X	X	—	—	—	Lapsed
8	Williams, L.G. (Ollmann-Williams Prospect)	1945	11	X	—	—	—	15	351 +	Patented claims

A* Airborne magnetometer and electromagnetic surveys.

Notes
See Map 2452, back pocket for location of properties and deposits.

LAKE SUPERIOR PROSPECT (3)

Lake Superior Mining Corporation Limited is believed to have staked some claims as early as 1945 (Bartley and Page 1957). During 1946, the majority of the claims were staked, and by 1949 33 claims partly encircled the property of L.G. Williams (Ollmann-Williams Prospect) (8) to the west, south, and east, and extended further west and east-southeast.

The staked area is underlain mostly by thickly-laminated to medium-bedded arkosic wacke, which is in part composed of volcanic detritus. Minor lenses of mafic tuff and flows and intermediate to felsic pyroclastic rocks are also present. The assessment file reports describe most of the rocks in the area as being wackes. The rocks of the area have been intruded by feldspar porphyries, particularly along a few fault-interpreted shear zones that were not delineated by the present field mapping. Some of these faults have been documented and extrapolated from stripping, trenching, and diamond drilling. In a few cases, prominent lineaments, as shown in the Hemlo area (Muir and Lafleur 1979), coincide with the described faults of the assessment files. Some of the faults are reported (Assessment Files Research Office, Ontario Geological Survey, Toronto) to have been traced for over 12 km, although this is not evident on the preliminary map (Muir and Lafleur 1979).

At least five types and ages of porphyry have been classified in the claim area (Assessment Files). In the author's opinion, the terminology is based in differences of colour and texture of diamond-drill core samples; the intrusive relationships were not established.

The main mineralized shear zone, the Lake Superior Shear Zone (Figure 15) extends west-northwest through the north side of Moose Lake just off Highway 17, and has been traced on the surface for over 11 km. Where most of the drilling has taken place, this shear zone strikes from 108° to 112°, dips 62° northeast, and locally has a width in excess of 37 m. A generalized section from hanging wall to footwall consists of 2.4 m of hanging wall porphyry, up to 14 m of "vein zone" host porphyry, up to 11 m of central or main porphyry, and 8 m of altered quartz porphyry. Some mineralization is within shear planes in the central (main) porphyry and consists of pyrite in both crystalline and "smeared" forms. Values of economic interest have been obtained from the "host" porphyry just above the central porphyry and are associated with bright, light-coloured, massive pyrite. Other mineralization consists of veinlets and massive pyrite within quartz stringers. Some visible gold was reported from one diamond-drill hole. Minor amounts of fuchsite, sillimanite, and molybdenite were also reported.

Exploration work during 1947 was concentrated along a strike length of 457 m on the Lake Superior Shear Zone centred about 0.6 km east of Moose Lake (*see* Figure 15). Initial X-ray diamond drilling consisted of 16 holes along this zone, however, only the results of seven holes totalling 317 m in length were submitted for assessment. Subsequent drilling, for which locations are not available, was undertaken in 1949, 1950, 1951, 1957, and 1959. In all, the results of 21 holes for a total length of 1665 m were filed for assessment, though more holes were actually drilled. Only a few assay results were filed with the drill logs and they reported trace amounts of gold. The exploration report refers to maximum values of $11.55 across 0.33 m, and $5.25 across 1.3 m in one hole.

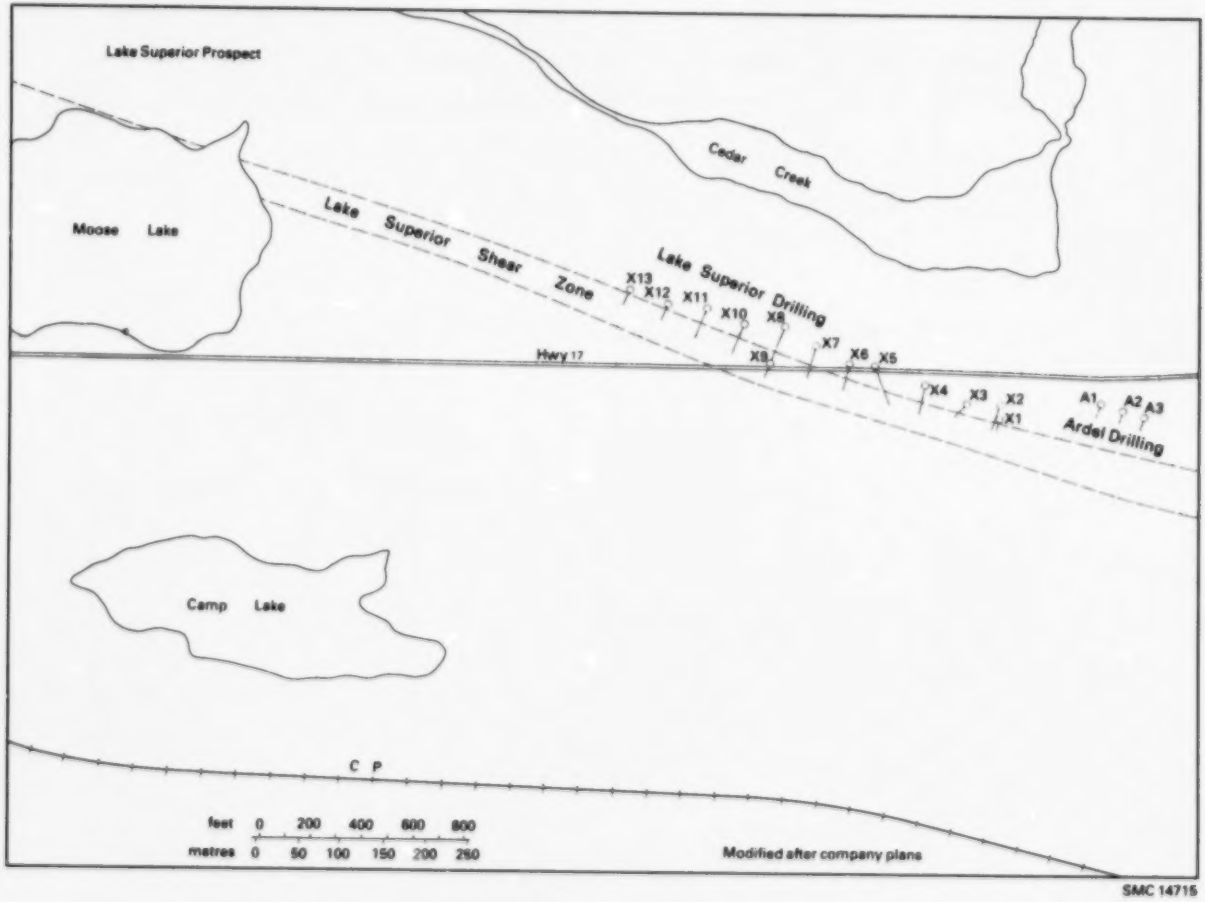

Figure 15–Approximate locations of diamond-drill holes on Lake Superior Prospect (3); drilling for Lake Superior Mining Corporation Limited and Ardel Explorations Limited.

At that time gold was approximately $35 per ounce. Further details are given in the section on Ardel Explorations Limited (1).

The claim group was allowed to lapse sometime after 1959 and parts of the area were subsequently restaked by Ardel Explorations Limited in 1973 and later by R.G. Newman about 1978.

R.G. NEWMAN (4)

In 1977, R.G. Newman staked and currently holds eight contiguous claims herein referred to as Group 1, and numbered TB441431 to TB441438 inclusive. These claims are located about 0.8 km north of Highway 17 and adjoin the west end of the L.G. Williams Property (8). In 1978(?) Newman also staked four contiguous claims herein referred to as Group 2 and numbered TB501974 to TB501977 inclusive. Group 2 straddles Highway 17 about 0.8 km east of Moose Lake and coincides with some of the ground previously held by Lake Superior Mining Corporation Limited and Ardel Explorations Limited (*see* appropriate sections by referring to Map 2452, back pocket). No work has been filed for Group 2, but the claims are in good standing.

The area near Group 1 has been staked several times in the past by other people, but there is no record of assessment and no evidence of activity was found by Newman. The area is underlain mainly by intermediate to felsic tuffs (possibly metasediments) and flows(?), and by arkosic wacke. Minor mafic tuff also underlies the west end of the claim group. Detailed mapping outlined numerous, small outcrops of feldspar-quartz porphyry. Minor disseminated pyrite mineralization is locally associated with the porphyries.

A VLF electromagnetic survey was conducted over the property of Group 1; no conductors were detected. In addition, a geochemical soil survey of A and (or) B horizons was undertaken and the samples were analysed for gold, silver, copper, lead, and zinc. A minor, multi-sample gold anomaly was outlined and was interpreted to overlie porphyry rocks. Four, one-station anomalies were also indicated; one sample reportedly gave a value of 10 000 ppm Au. Silver anomalies were small and insignificant; copper anomalies were not present; lead anomalies were unimportant; and two small zinc anomalies were partly coincident with some gold threshold values. No further work has been recorded, but the claims are in good standing.

NORANDA EXPLORATION COMPANY LIMITED (5)

In 1975(?) Noranda Exploration Company Limited staked four claims numbered TB445959 to TB445962 inclusive that are centred about 1.6 km north of Highway 17 from a point about 0.8 km east of Rous Lake. The purpose of staking the claims was to do follow-up work on some airborne electromagnetic conductors outlined from the "Dotted Lake Airborne Survey Area"[1]. The claims lie

[1]Resident Geologists Files, Ontario Ministry of Natural Resources, Thunder Bay.

mainly within the Black River valley and are mainly covered by sand and clay deposits up to 50 m thick. Exposed parts of the property consist of outcrops of intermediate to felsic tuffs, possible flows, and thinly-bedded arkosic wacke.

A VLF electromagnetic survey and a magnetometer survey were carried out over the property. Four anomalies were outlined, but were not followed up by more detailed surveys because of interference from the power transmission line about 1.3 km to the south. Three parallel magnetic anomalies were outlined, but they had no correlation with the VLF anomalies. No further work has been filed for assessment, but the claims are currently in good standing.

NORANDA MINES LIMITED (6)

In 1974(?) Noranda Mines Limited staked 31 contiguous claims, numbered TB421216 to TB421246 inclusive, that are centred northwest of Rous Lake. The northern part of the claims lies in the sand and silt-filled Black River valley where there are no outcrops. The southern part is underlain mainly by mafic flows and tuffs with minor intermediate to felsic tuffs. The southernmost part of the claims overlies the northern margin of the Heron Bay Pluton.

A VLF electromagnetic survey was conducted over the claim group; a number of short, discontinuous, small conductors were indicated. An exception was a 670 m long conductor near the west end of the grid where there is no outcrop. All conductors have been postulated to be caused by faults.[1] A magnetometer survey was also conducted and showed only a few small discontinuous magnetic anomalies that have been explained as the result of amphibolite units or talcose-chlorite dikes.

In 1975, four diamond drill holes located on claims immediately north to northwest of Rous Lake were drilled for a total length of 547 m. Foliated to gneissic amphibolitized mafic metavolcanics were mostly drilled along with some granitic rocks and minor lamprophyre, talc-chlorite schist, and feldspar porphyry dikes. Some diamond drill core samples were analysed for gold, silver, copper, and zinc, but values ranged from very low to nil. No further work has been filed, but the claims are in good standing.

NORANDA MINES LIMITED [1975] (7)

In 1974(?) Noranda Mines Limited staked four contiguous claims that straddled Highway 17 about 5.6 km west of Rous Lake. Outcrop occurs only on the south side of Highway 17 and consists of fine- to coarse-grained mafic metavolcanics, some of which may be tuffs.

A VLF electromagnetic survey was conducted over the area and outlined two conductors, one of which was interpreted as probably being produced by the power transmission line to the north. A second, more closely-spaced grid was

[1] Resident Geologist's Files, Ontario Ministry of Natural Resources, Thunder Bay.

put in and another survey was completed over the second conductor which was delineated for 610 m. Trenching showed this conductor to be the result of a fault.

A magnetometer survey was carried out on the claims. Two in-line anomalies that are coincident with the second electromagnetic conductor mentioned above were outlined. A second survey, on the more detailed grid, revealed three "parallel" broken bands of magnetic highs; the middle one being nearly coincident with the electromagnetic conductor. The other bands were interpreted to be the result of a relatively magnetic amphibolite unit or a magnetic, talcose dike found in the area nearby. The claims were allowed to lapse.

L.G. WILLIAMS, [OLLMANN-WILLIAMS PROSPECT] (8)

In 1945, Messrs. Ollmann and Williams staked 11 claims numbered TB32051 to TB32055 inclusive, and TB32154 to TB32158 inclusive, which have subsequently been surveyed and patented and are currently held by Mrs. L.G. Williams. Limited stripping and trenching were done in 1945 and revealed a persistent, strongly-sheared zone that traverses claims TB32054, 32051, 32154, 32053, 32158, and 32159. This same zone continues westward and eastward through property presently held by R.G. Newman.

The area is underlain predominantly by thinly-laminated to thinly-bedded argillite and arkosic wacke derived largely from intermediate to felsic unlithified volcanic material. Minor lenses of intermediate to felsic tuff may also be present. A series of porphyry-bearing shear zones are present on the property. The one of most economic interest consists of a west-northwest-trending feldspar porphyry. The contacts of this porphyry are strongly sheared and silicified, and contain gold-bearing pyrite mineralization. Beds south of the shear zone dip 60° to 70° to the north. The above-mentioned porphyry varies in width from 30 m to 53 m, and was traced on the property for about 0.8 km. Numerous, later, grey porphyries have intruded the host rock in a wide zone south of the footwall of the central or main porphyry[1].

Fifteen X-ray drill holes totalling over 351 m in length (the exact length could not be determined) were sunk through the main porphyry and the footwall shear zone. The shear zone varied from 6 m to 30 m in length in the drill core. A highly silicified mineralized zone consisting of porphyry sericite schist, and altered, schistose, sediment remnants, ranges in width from 12 m to 60 m. Assay results from highly pyritized parts of the shear zone returned low gold values; a maximum gold value of $4.20, when gold was approximately $35 per ounce, was obtained from all of the assay results. It was interpreted[2] that the relative lack in continuity of gold values among the different drill holes may indicate that the gold mineralization is localized in relatively short, lenticular bodies. Further work has not been recorded.

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[1]Assessment Files, Thunder Bay.

[2]Resident Geologist's Files, Ontario Ministry of Natural Resources, Thunder Bay.

RECOMMENDATIONS FOR FUTURE MINERAL EXPLORATION

In general, exploration work throughout the Hemlo area has not been extensive. Nevertheless, many of the known gold occurrences have received considerable attention in terms of surface sampling and diamond drilling. Assay results, however, have been uniformly poor. The most notable gold prospects, such as the properties of L.G. Williams (8) and R.G. Newman (4), are still too small and of insufficient grade to be economical at the present time; market conditions could change this situation (*see* footnote on page 50).

The ultramafic rocks in the west-southwest part of the Hemlo area are small in areal extent and are predominantly relatively low-MgO-bearing pyroxenite; therefore these rocks are not particularly conducive to sulphide mineral deposits (Naldrett and Arndt 1975). Other economic minerals related to ultramafic rocks were not observed during the field mapping.

The author believes that the best prospects for exploration, particularly with respect to gold, could be within a zone that parallels Highway 17 for about 1.5 km on either side.

REFERENCES

Ayres, L.D.

1972: Guide to Granitic Rock Nomenclature Used in Reports of the Ontario Division of Mines; Ontario Division of Mines, Miscellaneous Publication 52, 14p.

1974: Geology of the Trout Lake Area, District of Kenora (Patricia Portion); Ontario Division of Mines, Geological Report 113, 197p. Accompanied by Map 2270, scale 1 inch to ½ mile.

Bartley, M.W., and Page, T.W.

1957: Unpublished Geological Report on the Hemlo Area, Thunder Bay District, Ontario, for Canadian Pacific Railway Limited; Resident Geologist's Files, Ontario Ministry of Natural Resources, Thunder Bay, Ontario, 17p.

Bell, R.

1873: Report on the Country Between Lake Superior and Lake Winnipeg; Geological Survey of Canada Report of Progress 1872-73, p.87-111.

Bennett, G., Thurston, P., and Giguere, J.F.

1969: Operation Pukaskwa, Districts of Algoma and Thunder Bay; Ontario Department of Mines, Preliminary Geological Map P.541, scale 1 inch to 2 miles.

Gorman, B.E., Pearce, T.H., and Birkett, T.C.

1978: On the Structure of Archean Greenstone Belts; Precambrian Research, Volume 6, p.23-42.

Irvine, T.N., and Baragar, W.R.A.

1971: A Guide to the Chemical Classification of the Common Volcanic Rocks; Canadian Journal of Earth Sciences, Volume 8, p.523-548.

Jensen, L.S.

1976: A New Cation Plot for Classifying Subalkalic Volcanic Rocks; Ontario Division of Mines, Miscellaneous Paper 66, 22p.

Lang, A.H.

1952: Canadian Deposits of Uranium and Thorium; Geological Survey of Canada, Economic Geology Series Number 16, p.118.

McIlwaine, W.H., Fenwick, K.G., Scott, J.F., Mason, J.K., Schneiders, B.R., Kristiansson, F.J., Speed, A.A., and Bourdages, H.M.

1982: 1981 Report of the Thunder Bay Resident Geologist; p.39-69 *in* Annual Report of the Regional and Resident Geologists, 1981, Edited by C.R. Kustra, Ontario Geological Survey, Miscellaneous Paper 101, 184p.

Milne, V.G.

1968: Manitouwadge Sheet, Districts of Thunder Bay and Algoma; Ontario Department of Mines, Preliminary Geological Map, P.494, scale 1 inch to 2 miles.

Muir, T.L.

1979: Geology of the Heron Bay Area, District of Thunder Bay; Ontario Geological Survey, Open File Report 5261, 133p.

1978: Hemlo Area; p.90-93 *in* Summary of Field Work, 1978, by the Geological Branch, Edited by V.G. Milne, O.L. White, R.B. Barlow, and J.A. Robertson, Ontario Geological Survey Miscellaneous Paper 82, p.235p.

Muir, T.L., and Barnett, E.S.

1978a: Heron Bay Area (Northern Part), District of Thunder Bay; Ontario Geological Survey Preliminary Map 1981, Geological Series, scale 1:15 840 or 1 inch to ¼ mile. Geology 1977.

1978b: Heron Bay Area (Southern Part), District of Thunder Bay; Ontario Geological Survey Preliminary Map P.1982, Geological Series, Scale 1:15 840 or 1 inch to ¼ mile. Geology 1977.

Muir, T.L., and Lafleur, J.
1979: Hemlo Area, District of Thunder Bay; Ontario Division of Mines, Preliminary Geological Maps P.2304, P.2305, scale 1 inch to ¼ mile.

Naldrett, A.J., and Arndt, N.T.
1975: Volcanogenic Nickel Deposits with Some Guides for Exploration; American Institute of Mining, Metallurgical, and Petroleum Engineers Transactions, Number 260, p.13-15.

Nockolds, S.R.
1954: Average Chemical Compositions of Some Igneous Rocks; Geological Society of America Bulletin, Volume 65, p.1007-1032.

Ontario Department of Mines
1972: Manitouwadge Wawa Sheet, Algoma, Cochrane, Sudbury, and Thunder Bay Districts; Ontario Department of Mines, Map 2220, scale 1 inch to 4 miles.

Thompson, J.E.
1931: Geology of the Heron Bay Area, District of Thunder Bay; Ontario Department of Mines, Volume 40, Part 2, 43p. Accompanied by Map Number 40d, scale 1 inch to 1½ mile.

Winkler, H.G.F.
1976: Petrogenesis of Metamorphic Rocks; Fourth Edition, Springer-Verlag, New York Inc., 334p.

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Ministry of Natural Resources

Ontario

Ontario Geological Survey
Map 2452
Hemlo

Scale 1 inch to 50 miles

N.T.S. Reference 42D/9, 42C/12

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Bog, swamp, lake, and stream deposits; glaciolacustrine sand, fine sand, silt, clay, and varved clay

UNCONFORMITY

PRECAMBRIAN[b]

LATE PRECAMBRIAN (PROTEROZOIC)

ALKALIC INTRUSIVE ROCKS

12 Unsubdivided
12a Biotite gabbro, lamprophyre
12b Olivine ultramafic lamprophyre
12c Alkalic basalt

INTRUSIVE CONTACT

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

11 Unsubdivided
11a Equigranular diabase
11b Porphyritic (plagioclase) diabase
11c Quartz diabase

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

LATE FELSIC DIKES AND SILLS

10 Unsubdivided
10a Feldspar porphyry
10b Aplite
10c Pegmatite

INTRUSIVE CONTACT

CEDAR LAKE PLUTON

9 Unsubdivided
9a Hornblende-biotite granodiorite

HERON BAY PLUTON

8 Unsubdivided
8a Porphyritic (microcline) biotite-hornblende granodiorite
8b Hornblende-biotite granodiorite
8c Porphyritic (plagioclase) biotite-hornblende granodiorite
8d Hybrid rock

GOWAN LAKE PLUTON

7 Unsubdivided
7a Porphyritic (microcline) biotite-hornblende-quartz monzonite
7b Biotite-hornblende quartz monzonite
7c Hybrid rock

PUKASKWA GNEISSIC COMPLEX

6 Unsubdivided
6a Porphyritic (plagioclase) biotite-hornblende granodiorite (gneissic)
6b Porphyritic (plagioclase) biotite-hornblende trondhjemite (gneissic)
6c Biotite-hornblende granodiorite
6d Biotite-hornblende trondhjemite
6e Hornblende-biotite quartz monzonite
6f Hybrid rock

METAMORPHOSED ULTRAMAFIC INTRUSIVE ROCKS

5 Unsubdivided
5a Lherzolite, dunite
5b Peridotite, serpentinite
5c Pyroxenite
5d Chloritized
5e Talcose
5f Tremolitized

METAMORPHOSED MAFIC INTRUSIVE ROCKS

4 Unsubdivided
4a Gabbro
4b Schistose, gabbro dike

INTRUSIVE CONTACT

METAVOLCANICS AND METASEDIMENTS

METASEDIMENTS

3 Unsubdivided
3a Thinly-laminated argillite[c]
3b Thickly-laminated to thinly-bedded arkosic wacke and siltstone[c]
3c Thickly-laminated to thinly-bedded arkosic wacke and siltstone[c]
3d Medium-bedded arkosic wacke[c]
3e Massive to poorly-bedded wacke
3f Thinly-laminated to thinly-bedded siltstone, argillite
3g Mudstone, siltstone, argillite
3h Very thinly-bedded, migmatized wacke, siltstone
3i Magnetite-bearing (less than 10%)
3k Garnet-muscovite-biotite schist
3m Garnet-staurolite-biotite schist
3n Sillimanite-andalusite-cordierite-biotite schist
3p Garnet-anthophyllite-biotite schist

METAVOLCANICS

INTERMEDIATE TO FELSIC METAVOLCANICS

2 Unsubdivided
2a Foliated flows, tuffs
2b Pillowed flows
2c Tuff, lapilli-tuff, minor crystal tuff
2d Pyroclastic breccia, tuff-breccia
2e Migmatized tuff
2f Garnet-bearing

MAFIC METAVOLCANICS

1 Unsubdivided
1a Dark green foliated flows
1b Dark green amphibolitized, foliated flows
1c Pillowed flows
1d Varioltic flows
1e Pyroclastic breccia, tuff-breccia
1f Tuff, lapilli-tuff
1g Laminated epidote layers
1h Medium-to-coarse-grained
1i Garnet-bearing
1k Migmatized flows, tuffs

Ag Silver
Au Gold
mo Molybdenite

[a] Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts of the map.

[b] Bedrock geology. Outcrops and inferred extensions of each map rock unit are shown respectively in deep and light tones of the same colour. Where in places a formation is too narrow to show in colour and must appear in black, a short black bar appears in the appropriate block.

[c] Lithic clasts mostly intermediate to felsic volcanic material.

[d] Lithic clasts mostly mafic volcanic material.

The letter 'G' preceding a rock unit number, for example G9 indicates interpretation of geophysical data from largely drift-covered areas.

SOURCES OF INFORMATION

Geology by T. L. Muir, J. Lafleur and assistants, Ontario Geological Survey, 1978.

Geology is not tied to surveyed lines.

Assessment work data of mining companies, on file in the office of the Regional Geologist, Ministry of Natural Resources, Thunder Bay.

ODM-GSC Aeromagnetic maps 2156G and 2167G.

Ministry of Natural Resources (ODM) Map 40d, Heron Bay Area, 1931.

Preliminary maps (OGS) P.494, Manitouwadge Sheet, scale 1 inch to 2 miles, issued 1968. P1981, Heron Bay Area (Northern Part), scale 1 inch to ¼ mile, issued 1978. P1982, Heron Bay Area (Southern Part), scale 1 inch to ¼ mile, issued 1978.

Cartography by C. A. Love and assistants, Surveys and Mapping Branch, 1980.

Basemap derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by T. L. Muir, Ontario Geological Survey.

Magnetic declination in the area was approximately 3° W in 1978.

Parts of this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

MUIR, T. L.
1980: Hemlo, Ontario Geological Survey, Map 2452, Precambrian Geology Series, Scale 1 inch to ½ mile, geology 1978.

Published 1981

Ontario Geological Survey
Map 2452
HEMLO
THUNDER BAY DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles
Metres 1000 0 1 2 3 Kilometres
Feet 1000 0 5,000 10,000 Feet

SYMBOLS

- Glacial striae.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, top unknown: (inclined, vertical).
- Schistosity: (horizontal, inclined, vertical).
- Gneissosity: (horizontal, inclined, vertical).
- Foliation: (horizontal, inclined, vertical).
- Cleavage: (horizontal, inclined, vertical).
- Lineation with plunge.
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Fault: (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Jointing: (horizontal, inclined, vertical).
- Drag folds with plunge.
- Anticline, syncline, with plunge.
- Drill hole: (vertical, inclined).
- Sample location: Chemical analysis, thin section. See report.
- Muskeg or swamp.
- Motor road. Provincial highway number encircled where applicable.
- Other road.
- Trail, portage.
- Building.
- Township boundary, base line, with milepost: approximate position only.
- Township boundary, unsurveyed.
- Mining property, surveyed. Boundary approximate position only.
- Surveyed line, approximate position only.
- Mineral deposit; mining property, unsurveyed.

PROPERTIES, MINERAL DEPOSITS

1. Ardel Explorations Ltd [1973].
2. Keevil Mining Group Ltd. (Barret option) [1965].
3. Lake Superior prospect.
4. Newman, R. G.
5. Noranda Exploration Company Ltd.
6. Noranda Mines Ltd.
7. Noranda Mines Ltd. [1975].
8. Williams, L. G. (Oilmann-Williams prospect).

Information current to December 31st, 1978. Former properties on ground now open for staking are only shown where exploration data is available—a date in square brackets indicates last year of exploration activity. For further information consult report.

Adjoins Map 2439

COTTE
BLACK RIVER
Gowan Lake
Gowan Lake Pluton
Camp 36 Lake
Electric power transmission line
Botham Lake
ROUS LAKE
Cigar Lake
Pringle
Heron Bay Pluton
Campfire Lake
Bells Lake
Gulliver Lake
Elk Lake
Elephant Lake
Swamp Lake
Hayward Lake
Molson Lake
Handle Lake
Spangle Lake
Rule Lake
Rainsmon Chute
LECOURS
MUSSEY LAKE
HAYWARD LAKE
HERRICK LAKE
BOMBAY
Pukaskwa Gneissic Complex
White River
Cedar Creek
Phillipp Creek
Sand, silt
Sand
Sand dunes
Sand bars
Gravel
Muskeg